Environmental

Resource Inventory

A Data Base for Planning

ENVIRONMENTAL RESOURCE INVENTORY

A Report Prepared for

Bass River Township

with

the cooperation of the Township's

Board of Commissioners

Planning Board

Board of Adjustment

Environmental Commission

May 1974

FOREWORD

The Bass River Township Environmental Commission was created on 1 February 1973. One of its very first tasks was to apply for and obtain grants for matching funds from the State of New Jersey and from the Ford Foundation for the purpose of drafting a Natural Resources assessment that would be used ultimately in developing a master plan for the Township.

The Natural Resources Inventory was initiated by the Environmental Commission with the development of maps of the types and characteristics of natural resources associated with the water, land, soil, vegetation and wildlife. The maps, with abundant pertinent information are now available for guidance and use by the governing body of the Township and its Planning Board in the task of developing the Master Plan for Bass River Township.

These Township maps with their accompanying data shall be used to indicate the difficulties or advantages for various types of land use based on the characteristics of the natural resources within each area. The information and data gathered for this Natural Resources Survey are the result of much endeavor by a number of people who gave much of their time, effort and expertise to produce this report.

To the Mayor of Bass River Township, Floyd West and the other two members of the Board of Commissioners, Dr. Jonathon Ashton and Joseph Forgach, the Environmental Commission is most grateful. Their interest and dedication to the welfare and future of our township is an inspiration calling for our best efforts in producing a useful master plan which will provide an optimum of environmental quality for Bass River Township.

The Environmental Commission of
Bass River Township

ACKNOWLEDGEMENTS

The Environmental Commission gratefully acknowledges the contributions of members of several Township Commissions.

Township Commissioners

Mayor Floyd West
Dr. Jonathon Ashton
Joseph Forgach

Planning Board

Richard Bethea, Chairman
Harold Sheads, Secretary
Sarah Sheads, Clerk
John Schmid
Floyd West
Joseph Forgach
Thurman Seay - Vice Chairman

Board of Adjustment

Ron Criss, Chairman
Donald Mickens

Building Inspector

Robert A. Brown, Jr.

Environmental Commission

John C. Schmid, Chairman
Dr. Peter Suckling
Thurman Seay
Sarah Guertler
Mary E. Schmid, Secretary

Associate Members
Marietta Guertler
Dr. Joan Suckling

The research phases for the inventory were carried out by Mr. John Holland, A.I.P., consultation planner for Bass River Township and by Dr. V. Eugene Vivian, Executive Director, the Conservation and Environmental Studies Center, Inc. and Professor of Environmental Studies, Glassboro State College. Dr. Vivian was assisted by Mr. John Hiros and Mr. J. Donald Zollinhofer of the CESC staff and Mr. Carl Hedley and Mr. Clifford Daniels, graduate students at Glassboro State College. Mr. Curtis Read and Mr. Blaire VanValkenburgh, students at Stockton State College, supplied manuscript and references at the instance of Dr. Suckling, who played a significant role in organizing the inventory.

The history of Bass River Township was authored by Mrs. Sara Mathis Guertler, and several maps were developed and projected by Mr. John Schmid. Mr. Fred Mahn, Soil Scientist for the Soil Conservation District of Burlington County prepared the group water map. Mayor Floyd West developed textual materials on housing and population. John and Mary Schmid prepared extensive lists of fauna and flora. The printing of all map figures was done by Mr. John Holland and his staff. The logo for the cover of this report was designed by a local artist Mrs. Margaret S. Johnson.

The entire manuscript was collated and edited by Dr. Vivian. Special thanks go to Ms. Betty Stohrel of the CESC staff who typed the manuscript and the office staff of CESC who reproduced and collated the inventory.

AN ENVIRONMENTAL INVENTORY

for

BASS RIVER TOWNSHIP

TABLE OF CONTENTS

MAPS

Chapter I

Location and Geographic Description

Bass River Township occupies some 77 square miles in the southeasterly extremity of Burlington County, New Jersey. The area is close to the center of the east coast area of the United States, the megalopolis area extending from Boston to Washington. The township is 16 miles north of Atlantic City and about 55 miles southeast of Philadelphia. It contains most of the Bass River State Forest and some sections of the Wharton State Forest. (See Figure 1).

The southern part of the township contains the small town of New Gretna and is traversed by sections of route 9 and the Garden State Parkway. As the crow flies, New Gretna is about 15 miles north of Atlantic City; 46 miles southeast of Philadelphia; and some 85 miles south of New York City.

The township is bordered on the south and west by important public land areas — the Brigantine National Wildlife Refuge; the Port Republic Fish and Wildlife Management area; and the Wharton State Forest. It is located midway between the east--west transporation corridors connecting the Philadelphia - Camden metropolitan region with the Atlantic City and Toms River coastal areas.

There are coastal barrier beach islands such as Long Beach Island some miles to the east which are very heavily populated with vacationers during the summer months. Areas to the west with communities such as Egg Harbour City, Hammonton and further away, Vineland, are intensively farmed. The adjacent township to the north east, Little Egg Township is being developed for residences at a very rapid rate. Residential and industrial development is also proceeding rapidly in communities west of Atlantic City, particularly in Pleasantville, Northfield and Linwood.

The communities mentioned in the previous paragraph and the Fort Dix Military Reservation to the north surround an area of roughly a million acres which is naturally forested and which carries a low population density. It is the remainder of what has been known as the New Jersey Pine Barrens. A substantial part of the area is watershed for the Wading, Mullica and Bass Rivers and is far from being barren. Bass River Township occupies 50,000 acres of this forested land. It is separated by an area of salt marsh from Great Bay which opens onto the Atlantic Ocean six miles away. Tidal creeks run from the lower southern part of the township into Great Bay.

Chapter 2

A History of Bass River Township

Bass River Township in its political entity was created by an act of the Legislature of the State of New Jersey on March 30, 1864. It contained a part of Washington Township but most of its territory was taken from Little Egg Harbor Township. The bounds were defined by a supplement to the original act which described them as follows:

> "Beginning opposite the mouth of Belangy's Creek, in the division line of Burlington and Atlantic counties, thence running a northerly course up the said Belangy's Creek, the several courses thereof, to the bridge on the main stage road from Bass River to Tuckerton, thence in a northerly course to a point on the county line between Ocean and Burlington counties, when a due west course will strike a bridge known as Lauries' Bridge, on the line of Washington Township, thence along Washington Township line to the east branch of Wading River, thence down the said stream to the mouth of Harrisville canal, thence along said canal to the Speedwell stream, thence along said stream to its mouth, thence down Wading River to the place of beginning."

The name is derived from Bass River which rises in the northeastern part of the township. The first settlement appears to have been made on Daniel Mathis' Island on the east bank of Bass River in 1713. The early settlers were for the most part Quakers who came from England. They bought large tracts of land upon which they built their homes and farms. They were resourceful, independent people, skilled in hunting, fishing, blacksmithing, coopering, carpentering, tanning and shoemaking. The women spun wool and flax, made the dye for the yarn and wove it into cloth for bedding and wearing apparel. Many persons living in Bass River Township at the present time are descended from the early settlers. Some still possess articles made from the homespun.

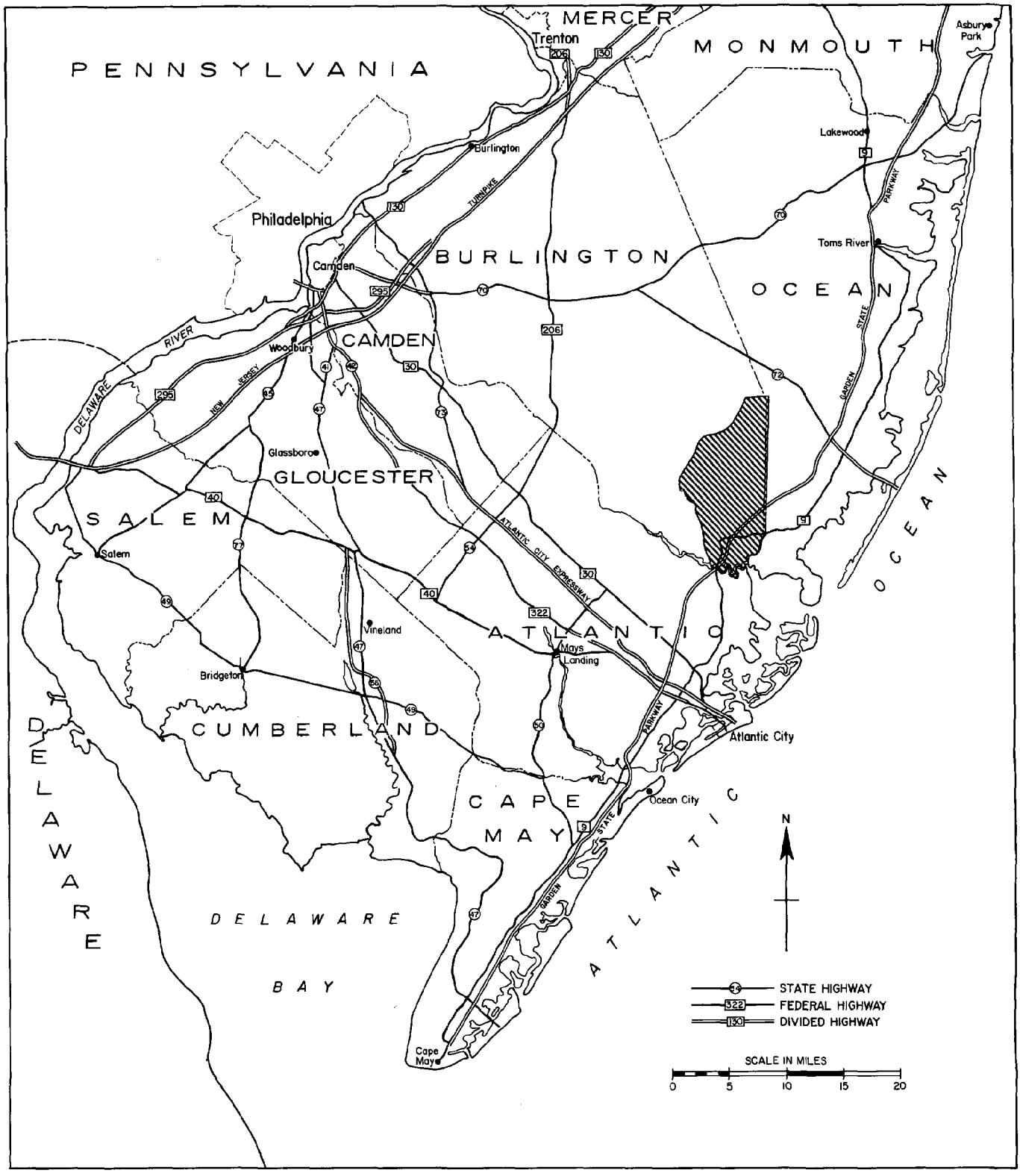
When Tuckerton, on September 17, 1787, became the third port of entry in the United States, it influenced industry in the township. Shipbuilding was carried on in two locations on Bass River. The first vessel built was the brig "Argo" in 1800. Many cargo vessels were registered to owners and operators in Bass River. Exports were sent to New York, Philadelphia, and Rhode Island, from which places they might be shipped to the southern colonies, to the West Indies, or overseas. Some engaged in direct trade with the West Indies.

Lumbering and fishing offered a livelihood to many men. Woodchoppers and charcoal burners were employed in large numbers to serve the bog iron industry. Sawmills turned out lumber in great quantities, much of it for export. Barrel staves, to be used in making hogsheads in the West Indies, were an important commodity. Ancient white cedars, three feet and more in diameter, were dug up or

FIGURE I

LOCATION MAP–BASS RIVER TOWNSHIP

SOUTHERN NEW JERSEY



"mined" from the waters of the swamps and converted into shingles of superior wearing quality. (There is, even today, a man engaged in mining cedar at Merrygold, a small tributary of the Wading River within the township.)

The iron industry required tremendous capital resources, expert management and technical skills. In addition to the mines themselves, forests were needed to supply the charcoal used in smelting the ore. Limestone, usually in the form of oyster shells, was required as a flux in the forges. Water power was essential to operate the bellows and other machinery. Also, because the operation had to be carried on in remote areas, the ironmaster had to provide a self-sufficient community for his numerous workers.

Martha Furnace, on the east branch of Wading River just above Harrisville Pond, was established in 1793. According to T. F. Gordon, "Gazetteer of New Jersey", 1834:

> "The furnace makes about 750 tons of iron castings annually and employs about 60 hands, who, with their families, make a population of near 400 souls, requiring from 40 to 50 dwellings; there are about 30,000 acres of land appurtenant to these works."

The Martha Furnace Diary, a journal kept from 1808 to 1815 by Caleb Earle, an observant clerk, and other sources, give a detailed picture of this community. Martha Furnace was closed down in 1840. However, many of the workmen continued to live in the village of Calico and engaged in the manufacture of charcoal.

Two years after Martha Furnace was established, the Wading River Forge and Slitting Mill was built on Harrisville Pond. This mill processed the pig iron bars into sheets and strips of metal of commercial size. A canal was built to enable the barges from Martha to by-pass the dam.

In the 1830's a paper mill was begun at Harrisville. A heavy grade of paper was made from salt hay from the marshes. In the 1850s it was the largest paper mill in New Jersey. Harrisville was a thriving community. The main street, lit by gas lamps on ornamental posts, was part of the road that led to Bodine's Tavern and "The Landing" at Wading River or Bridgeport. It was the center of an industrial area with five bog iron furnaces not far away. The store was a shopping center for workmen and farmers from miles around. A survey of the plant dated August 1877 by A. Hexamer gives a very good picture of Harrisville in its heyday.

After financial difficulties Harrisville was sold at Sheriff's sale on July 16, 1896 to Joseph Wharton, a Philadelphia industrialist and financier. It remained a ghost town until destroyed by fire, the ever present threat in the Pine Barrens, in 1910.

Joseph Wharton had the dam rebuilt at a cost of $30,000. In 1974, the State of New Jersey, owner of the vast Wharton Tract which includes Martha and Harrisville, is rebuilding the dam at a cost of $500,000.

Bass River State Forest was initiated as a public recreation area in 1905. Besides its recreational facilities which include camping, fishing and swimming, the aim of the state is to conserve water supplies, timber and protect wildlife. Penn State Forest is another state-owned recreational area.

Following the development of the state parks, many privately owned campsite and recreational areas were established until the provision of recreational facilities and the cultivation of cranberries are the chief enterprises and account for the major land use in the township.

The fisheries, particularly shell fish, are still a major industry as well as lumbering, hunting, and the cultivation of blueberries. A wood carver and a glass blower have located at Mathistown along U.S. Highway 9 and are well known for their unique skills. There are two marinas on the Bass River. Also, the Viking, a luxury pleasure boat, is built on the site where the first brig was constructed in 1800.

New Gretna has been the center of population in Bass River for over one hundred years. The Methodist and Presbyterian churches and cemeteries are here. The elementary school, volunteer fire company, post office, a new bank, a bakery, restuarants, taverns and stores are a part of the village.

Long before the Revolution, this lovely locality had a compeling appeal for the enterprising men. The valuable water resources have been preserved, each in their special way, by the cranberry and shellfish industries, Joseph Wharton and the State of New Jersey. The state has declared 75 acres on the eastern shore of Lake Absegami and 440 acres of the Calico Ridge-Martha Tract to be areas having natural significance. Sim Place, 3000 acres vital to the Wading River ecosystem, has been proposed for state acquisition and preservation.

Bass River offers quiet streams and wooded trails for the regeneration of the spirit. Perhaps the asphodel, (Tofieldia racemosa) whose white "spikes of starry flowers" so delighted the naturalist, Witmer Stone, in a savanna by the Wading River, could become a symbol of this region, "the perfect image of delicate simplicity.

Chapter 3

The Climate, Geology and Soils of Bass River Township

Climate

Bass River Township enjoys a climate typical for the coastal plain of Southern New Jersey. Except for those locations immediately adjacent to water bodies such as the Bass River, Wading River and the Great Bay, the climate is not particularly affected by its proximity to the Atlantic Ocean coastline.

The average monthly rainfall for nearby Chatsworth is shown on the accompanying table. From Great Bay to the forested "lower plains" area in the northeastern section of the Township, the annual rainfall ranges from forty-four to forty-eight inches. (See Figure 2).

Climate Data Average Monthly Temperatures (Degrees F)

	Chatsworth		
	1969	1970	1971
January	30.0	24.9	27.7
February	32.0	33.5	35.7
March	38.5	37.6	40.1
April	53.2	50.0	49.0
May	62.2	63.5	59.2
June	71.2	70.4	71.8
July	73.4	74.6	74.2
August	74.3	74.6	73.2
September	66.6	70.5	69.7
October	55.3	57.2	62.6
November	44.4	47.3	45.1
December	33.1	37.1	42.8

Source: U.S. Department of Commerce, Climatological Data, New Jersey Annual Summary (1969, 1970, 1971)

Topography and Geology of Bass River Township

Bass River Township lies entirely within the Atlantic Coastal Plains, a physiographic province which extends along the sea coast from Cape Cod and Long Island to Flordia. For the most part, the Coastal Plain consists of unconcolidated sands, silts, clays, and marls. All of these formations are easily eroded at about equal rates, which therefore result in a lack of high relief. Streams have thus created a gently rolling terrain which slopes gently to the ocean.

In New Jersey, the Atlantic Coastal Plain has been divided into three physiographic subdivisions (Owens and Minard, 1960): the innerlowland, the inner upland, and the outer lowland. In Burlington County, the inner lowland is the area bordering the Delaware River, where elevations rarely exceed 100 feet. Streams in the inner lowland drain to the Delaware River. Rancocas Creek is the principle drainage basin tributary to the Delaware River.

The inner upland, which forms the drainage divide in the county, is a narrow, highly dissected plateau with elevations up to 200 feet. Erosional remnants of this plateau form the prominent hills of Mount Holly, Juliustown and Arney's Mount. The sands and gravels in these hills have been partially cemented by iron oxide precipitated from water percolating down through the ground. The reddish-brown iron oxide cement increased the resistance of the formation to erosion. As a consequence, these areas that are cemented remain as hills. Fort Dix and McGuire Air Force Base are on this plateau which forms a poorly developed northeasterly facing cuesta just to the northeast of the military reservations.

Southern Burlington County lies within the outer lowland where elevations rarely exceed 50 feet. Streams within this subprovince empty into the Atlantic Ocean. Sloping gently toward the sea, the flat terrain of this area has been somewhat modified by the Mullica, Wading and Bass Rivers.

Paleozoic Era

The "basement" rocks on which the Coastal Plain sediments were deposited formed at this time. A deep, elongate basin extended from Newfoundland down through New England, New York and New Jersey across eastern and central Pennsylvania, western Virginia and the central Carolinas into Alabama. Sediments accumulated in the basin as it slowly subsided until the end of the Paleozoic Era when the seas retreated.

The Appalachian orogony, a period of mountain building occurred at the end of the Paleozoic. Intrusion of hot, molten granitic magmas caused the previously deposited sedimentary rocks to be changed or metamorphosed into gneiss and schist. This gneiss is coarsely grained with bands of light and dark minerals which are easily seen. Schist is finer grained and is dominated by clearly visible flakes of some platy mineral such as mica.

Known as the Wissahickon Formation, the gneiss and schist do not appear on the surface in Burlington County. Well records show that the Formation underlies the younger unconsolidated formations at depths from 50-150 feet along the Delaware River. Toward the southeast, where the unconsolidated formations thicken, the depth to bedrock is greater. This "basement" of crystalline rocks dips toward the ocean at a rate of about 80 feet per mile, to a depth of 3,750 feet at Island Beach.

Mesozoic Era

During the Triassic and Jurassic periods, a peneplain was formed. A peneplain is a nearly featureless plain developed by long, continuous erosion of a stable crust. This peneplain in Burlington County is the surface of the above mentioned Paleozoic crystalline rock "basement".

Early in Cretaceous time, the Coastal Plain was depressed on the east while the northern areas of New Jersey were uplifted. This increased the velocity of the streams in northern New Jersey. With increased velocity there was more rapid erosion of the softer rocks such as shale and linestone. For a while, Burlington County was subjected to continued erosion, but later, sediments carried from the northern mountains were deposited in Burlington County.

These sediments, carried by the southeastward flowing streams, were first deposited within stream channels and estuaries along a fluctuating shoreline. Thus, the Magothy and Raritan Formations, which are now exposed in a narrow band along the Delaware River, were deposited in an environment which was part stream, part estuary, and part near shore marine. Marine and non-marine sediments are found interfingering within this series of variable alternating clays and sands. Plant fossils in the non-marine stream deposits and marine fossils in the sea deposits enable us to interpret the diverse conditions under which the sediments were deposited.

Subsidence continued to be the dominant force throughout late Cretaceous time. The sea transgressed until all of south and central New Jersey was under water. Abundant quantities of glauconite, an iron magnesium silicate mineral, were precipitated in the shallow waters of the Continental Shelf. This green mineral was incorporated in the mica-rich sandy clay producing the green, quartz-glauconite clays and sands of the Matawan Group. The formations which compose the Matawan Group are, from oldest to youngest, the Merchantville and Woodbury clays, the Englishtown Sand and the overlying Marshalltown formation. These green to black clays and sands contain occasional fossil clams, oysters and brachiopods and abundant remains of microscopic protozoa. Textural and faunal evidence suggests variation between near shore lagoonal deposits and the deeper water deposits of the continental shelf environments.

The uppermost formation of the Matawan group ranges from a dark gray lignitic, micaceous, clayey silt to a fine quartz sand with moderate amounts of glauconite.

The overlying Mount Laurel, Navesink and Red Bank Formations suggest that similar changes in sea level sedimentation prevailed to the end of the Cretaceous Period. The characteristics of each of these formations can be studied by going to the locality after which it is hamed. Red Bank, however, refers to the "Red Bank" of Monmouth County rather than "Red Bank" in Gloucester County on the Delaware. The "Red Bank" formation is red on the surface due to the oxidation of the glauconite. The "Red Bank" on the Delaware is a local condition within the Raritan formation.

The sediments of the Monmouth group, also marine deposits, are similar to the Matawan group, however, they do not contain the abundant mica and lignite found in the Matawan beds. The Mount Laurel Sand, which forms the bottom unit of the Monmouth group, is a slightly clayey, glauconite, fine to coarse quartz sand.

Overlying the Mount Laurel Sand, the Navesink Formation is composed of greenish black glauconite sand and gray clay. The Navesink is one of the most fossiliferous formations in this group. The clay content of the Navesink increases upward through the formation, usually accompanied by an increase in micaceous silt. Beds of glauconite sand are usually interbedded with the clayey beds in the upper part of the formation.

The Red Bank overlies the Navesink. It is difficult to distinguish the contact between the two formations. Pyrite, lignite, and mica is prominant as accessory minerals associated with the major constituents, clay and glauconite sand.

Cenozoic Era

During the early part of the Cenozoic Era the seas retreated. After a short interval of erosion followed by subsidence of the land the sea invaded New Jersey again. The formations of early Tertiary time are similar to those of the underlying Matawan and Monmouth Groups.

The Hornerstown sand, chiefly composed of dark green clayey glauconite sand was deposited on the eroded Cretaceous surface (peneplain). In weathering, the formation produces large amounts of ironstone (see "Peanut Brittle Rock" below). Distinguishing this formation from the underlying Monmouth group is sometimes difficult. One criterion is the color of the clay, in the unweathered Monmouth, a grayish-black; while in the Hornerstown, the unweathered clay is green.

Above the Hornerstown is the Vincentown formation, which varies from a clean quartz sand, through clayey, limey sand to a poorly cemented limestone. The limestone is a lime sand reef environment containing fossil foraminifera, bryozoa, and corals.

Overlying the Vincentown formation is the Manasquan formation. The lower part is composed chiefly of glauconite but the upper part is made up of very fine sand mixed with greenish white clay. Fossils are not abundant and are poorly preserved.

The sea withdrew after deposition of the Manasquan formation and there was a period of erosion. When the sea again invaded the area, the sediments of the Kirkwood, which is most commonly a fine micaceous quartz sand, were deposited. In many places it is delicately banded in shades of salmon-pink and yellow. Ilmenite is the principal accessory mineral, although some black lignitic clays occur at or near the base of the formation in some localities. Fossil shells are not abundant but can be found occasionally in localized pockets where favorable conditions existed.

There was a brief period of erosion following the deposition of the Kirkwood, which left an irregular surface. The sea again invaded New Jersey, depositing the gravel, sand, and clay of the lower part of the Cohansey formation.

The Cohansey is composed of quartz sand with clay laminae and thicker lens-shaped beds of light colored clay. Occasionally there are lenses of gravel, which may include ledges of "Peanut Brittle Rock". Some of these ledges form ridges, such as Arney's Mount. Ilmenite, again, is an important accessory mineral.

Pleistocene - In many parts of Burlington County yellow gravels or yellow gravel and sand are found from a few inches to several feet in thickness on the land surface. These gravels are particularly abundant within about 15 to 20 miles of the Delaware River and also in the southwestern part of the county east of Pleasant Mill and Speedwell. On the State Geologic Map these formations are designated as the Beacon Hill gravels, the oldest material found as remnants on the top of some of the higher hills, such as Bear Swamp Hill and Spring Hill. In some texts and maps this gravel is given as being of Pliocene age. Much more extensive areas are covered by the Bridgeton gravels or at even lower elevations, the Pennsauken gravels or the Cape May formation.

As originally mapped, the gravels had rather distinct limits as to the elevation of their occurrence and supposedly had a distinctive lithology. Although the concepts of origin and distribution were sound at the time they were proposed and the formations were named, the whole story was based on one late Pleistocene glacial ice advance. More recent work indicates that the last, or Wisconsin, glaciation in New Jersey had four periods of advance, at least two of which resulted in glacial ice covering some of the northern part of the State. It seems more probable, as we learn more of what happened during the Ice Age, that the origin of these gravels is more complex than it was originally thought, and that they may be related to the several Wisconsin ice stages as well as to earlier Pleistocene events.

In any event, regardless of their age and exact origin, streams deposited sheets of yellow gravels and sands in the stream valleys of Burlington County in Pleistocene time. Occasionally, one may observe large boulders, which were apparently caught in ice blocks which had broken off from the ice front in northern New Jersey, were rafted downstream until the ice supporting them had melted away and dropped them on the bottom. Since the deposition of these bodies of sand and gravel, post glacial erosion of New Jersey has removed the former higher hills, which were unprotected by the gravel, so that there has been an inversion of the topography. The stream valleys of today were the ridges of years ago and the valleys of that time are now the ridges and terraces covered with the yellow gravel which we find over much of northwestern and southeastern Burlington County today. Many of these gravel deposits are the only economic source of gravel in the county. Therefore, many of the thicker deposits have been removed in the last 50 years for the construction of roads,

houses and factories.

One can almost say that above an elevation of about 50 feet, if you wish to find gravel, you should look on the top of the nearest hill. Most of central Burlington County is the sand of the Cohansey formation. In the vicinity of Pasadena, along the Ocean County line, the gravels on top of the hills are correlated with the above mentioned Beacon Hill gravels.

Most of central Burlington County has now been eroded to a level such that the existing streams have such a low gradient that they can remove only the finest sand and silt. Areas underlain by clay-rich beds are frequently swampy, and it is in these areas that we find the bog irons and cranberry bogs.

Mineral History

Historically, the most famous and interesting mineral resource of Burlington County is the extensive bog iron deposits found in the Pine Barrens. During the peak of bog iron mining, about 1830, fourteen furnaces were operating in southern New Jersey. Of these, Atsion, Batsto, Hampton, Martha, and Mary Ann Furnaces are located in Burlington County. With the discovery of the more economically mined higher grade magnetite ores of northern New Jersey, the bog iron industry declined. By 1868 all of the bog iron furnaces had been abandoned.

Some of the largest and highest grade bog iron deposits of the state are in the extensive swamps and wet meadows of the Mullica and Wading Rivers and their tributaries. Water travelling through the ferruginous clays and sands picks up oxides or iron. Carbonic acid, the agent by which the iron is retained in the dissolved state, is lost when the water comes in contact with the atmosphere, particularly if there is some agitation by waves and an abundancy of sunlight. The iron oxides are then quickly precipitated along the banks and flood plains of the streams.

Tree trunks and stumps buried in the swamp muds have been completely replaced by iron oxides from waters percolating through the ore beds.

By volume, 65-75% of the ore is iron oxide, the actual metallic iron content of the ore ranges from 45-55% by volume, High concentrations of sulfur and phosphorus in the ore make it unsuitable in the manufacture of stell, a factor which contributed to the decline of the bog iron industry.

The most recent mineral resource to be discovered in Burlington County was the concentrations of ilmenite in the sands of the Kirkwood and Cohansey Formations, which cover the southeastern two-thirds of the county. Ilmenite is a relatively heavy, dark gray to black mineral from which Titanium oxide is recovered. Ilmenite sand is used in the manufacture of paint pigments. The highest concentrations of the sand are in the vicinity of Medford Lakes and Browns Mills, where they are currently being mined. These deposits are believed to have originated from the reworking and consequent concentration of the heavy mineral grains in the sands by the surf on beaches and tidal currents in the estuaries.

A once valuable New Jersey mineral resource was the abundant glauconite of the greensands and marls of the Coastal Plain. Glauconite was used as an agricultural fertilizer because of its high potassium concentrations.

Among the most extensive of the country's natural resources are the sand and gravel deposits. Sand pits in the Cohansey Formation are the source of mortar sand and concrete pebble aggregate. In several localities, the Cohansey sand is such pure silica (quartz) that the sand is worked for the production of glass. At Arney's Mount, in time past, there was a major source of the ironstone used for farmhouses and out buildings.

In summary, the geologic formation at the surface in Bass River Township is chiefly from the Cohansey Formation, generally a yellow to whitish quartz sand. The southern third of the township has greater or lesser depths of the Cape May Formation lying atop the Cohansey from a few inches to several feet in thickness. The Cape May Formation is found along all water courses in Southern New Jersey. At two or three localities the highest elevations in the northern portion of the township, there is a capping of the Bridgeton Formation which is often identifiable by its more pebbly appearance at the surface.

SOILS

The soils of Bass River Township are composed of five associations:

1. The Downer - Sassafras - Woodstown Association found in New Gretna and in the vicinity of Route 9 and the Garden State Parkway.

2. The Lakehurst - Lakewood - Evesboro Association which comprises much of the dry, upland forested areas along with the

3. Woodmansie - Lakehurst Association.

4. The Atsion - Muck - Alluvial land, sandy association which borders all the streams with the exception of the tidal marshlands which are designated

5. Tidal Marsh Association.

LAKEHURST SERIES

The Lakehurst series consists of deep, loose, moderately well or somewhat poorly drained sandy soils that have a bleached horizon 7 or more inches thick. Slopes range from 0 to 5 percent. These soils formed in coarse water-laid deposits on the outer Coastal Plain. They are the most extensive soils of Burlington County.

In a typical profile the surface layer is gray sand about 3 inches thick. The subsurface layer is light-gray sand about 12 inches thick. The subsoil, about 25 inches thick, is dark-brown loamy sand in the upper 3 inches and yellowish-brown sand mottled with grayish brown below. The substratum is pale-brown sand.

Lakehurst soils are very strongly acid and very low in natural fertility. Added fertilizers leach readily. The content of organic matter is very low. Because these soils are loose, they are subject to soil blowing and, on slopes, to water erosion. The fluctuating water table in these soils starts to rise in about October, rises to about 2 feet from the surface by late in winter or early in spring, and drops shortly after spring. Since plants use more water in summer than in other seasons, this water table is of value only to deep-rooted plants. Lakehurst soils have rapid or moderately rapid permeability and a low or very low available water capacity. They can be readily drained by widely spaced ditches or underdrains.

The natural vegetation is mostly pitch pine mixed with black and white oack, blackgum, and hickory trees. The understory includes lowbush blueberries, gallberries, and scattered sheep laurel. The sheep laurel generally has roots deep enough to reach the water table. Where wildfires have been severe, there are few hardwoods except scrub oak and blackjack oak. Where wildfires have been extremely severe, the trees are dwarfed to a height of about 4 to 6 feet regardless of age.

SASSAFRAS SERIES

The Sassafras series consists of well-drained moderately coarse textured soils formed in water-laid deposits that contain little or no glauconite. Although the surface layer and the subsoil have the same textural class, the subsoil distinctly contains more clay than the surface layer. The substratum is very sand and contains large amounts of gravel in places. These soils are mostly nearly level or gently sloping, though they have slopes of 5 to 10 percent in some places.

In a typical profile, the surface layer is dark grayish-brown fine sandy loam about 10 inches thick and the subsurface layer is yellowish-brown fine sandy loam about 4 inches thick. The subsoil is fine sandy loam that extends to a depth of 34 inches. It is dark brown in the upper 14 inches and yellowish brown below. The substratum is light yellowish-brown loamy sand containing some gravel.

Sassafras soils are moderately permeable. The available water capacity, organic-matter content, and fertility are moderate except where the surface layer is loamy sand. The loamy sand has moderately low available water capacity and fertility and low organic matter content. Sassafras soils are very strongly acid unless heavily limed.

The native vegetation is a hardwood forest consisting mostly of red oak, white oak, black oak, scarlet oak, hickory, beech, yellow-poplar, and scattered Virginia Pine.

WOODMANSIE SERIES

The Woodmansie series consists of well-drained soils that have a bleached sand subsurface layer and a finer textured mostly sandy loam subsoil. The substratum is generally loose sand. These soils are mainly nearly level to gently sloping, but a small acreage has slopes of 50 to 10 percent. Woodmansie soils formed mostly on high positions, especially those above 150 feet in elevation. In most places they formed on Beacon Hill gravel.

In a typical profile, the surface layer is dark-gray sand about 2 inches thick and the subsurface layer is gray sand about 6 inches thick. The subsoil extends to a depth of 30 inches. It is light yellowish-brown sand in the upper 9 inches and yellowish-brown sandy loam below. The substratum is stratified yellow sand and reddish-yellow sand loam.

Permeability of these soils is moderately rapid, except that it is moderately slow in substratum in some places. The available water capacity is low, and excess water is rarely in the profile. Because the surface layer is bleached, organic-matter content is low and fertility probably is low. Since Woodmansie soils are not cultivated, fertility can only be deduced. Forest stands are so severely damaged by wildfires, that they do not reliably indicate soil fertility.

The native vegetation is believed to have been a hardwood forest consisting mostly of black oak, white oak, scarlet oak, chestnut oak, and hickory and a scattering of pitch pine, shortleaf pine, and Virginia pine. Becasue Woodmansie soils occupy high positions and nearly all wildfires burn the hilltops, the dominant vegetation is now mostly pitch pine, scrub oak, and lbackjack oak. Where wildfires have been very severe, the trees are dwarfed to less than 5 feet high, though they may be more than 50 years old. Pines seed readily where these soils are left bare.

THE ATSION – MUCK – ALLUVIAL LAND, SANDY ASSOCIATION

Atsion

The Atsion series consits of poorly drained, dark-gray sandy soils that formed on the borders of swamp and the bottoms of some circular depressions in the outer Coastal Plain. These soils are also on extensive terraces adjacent to the Mullica, Batsto, and Wading Rivers. The terraces contain numerous narrow and intermittent streambeds. Since these soils are nearly level and in low positions, they receive runoff from the slopes above.

Because of the high water table, Atsion soils warm late in spring. Where drained, they have a low available water capacity. When the water table is low enough to permit percolation, permeability is moderately rapid. These soils have moderate organic-matter content and low fertility. Added fertilizers leach readily. Since few areas have been limed, Atsion soils are very strongly acid in most places.

When rainfall is normal, Atsion soils are saturated 6 to 8 months of the year. The water table starts to rise in October, reaches its peak of about 1 foot from the surface, and drops to about 2 feet below the surface by the end of May. In some areas drained for blueberries, the water level is 3 feet below the surface in summer. In extremely dry summers, some drained areas have a water table below 5 feet.

Native vegetation on Atsion soils is a stand of pitch pine and scattered scrub oak trees and a dense understory of highbush blueberry, sheep laurel, sweet pepperbush, gallberry, and greenbrier.

Alluvial land, sandy

This land consists mainly of thick deposits of loose, coarse sand and gravel adjacent to the larger meandering perennial streams in the outer Coastal Plain. Most of the land is subject to annual flooding every 5 to 10 years. Except for a dark surface layer, the soil material has few well-developed horizon features.

This land has a constantly high water table that is controlled by the adjacent stream. This water table is at the surface in winter and, except during extreme drought, it drops only about a foot in summer. The soil material is rapidly permeable, low in fertility, and extremely acid. Where this land is rained, the available water capacity is low in the sandy areas but is high in the mucky areas. Frost heave is slight on the sand and severe in mucky areas.

The native vegetation varies. Atlantic white-cedar grows in the mucky areas, and pitch pine, red maple, blackgum, gray birch, and bay magnolia grow in the sandy areas.

Muck

Muck, shallow consists of about 2 feet of black, finely decomposed, saturated organic matter, generally over sand and gravel but over clayey material in places. In a few places this organic layer is less than 1 foot thick or more than 3 feet thick. Fire has reduced the thickness in places. Included with this muck in mapping are small areas of sandy soil.

Muck forms in nearly level areas at the headwaters of streams or where the stream flow is slow. Most of these streams flow eastward to the Atlantic Ocean, but there are also areas of Muck along some of the westward flowing streams. Muck also occurs in round depressions that have no drainage outlet. Muck commonly is associated with Berryland and Atsion soils and Alluvial land, sandy. It can be distinguished from these soils by its high content of organic matter.

Except for some places that support no trees, the native vegetation on Muck is a dense forest of Atlantic white-cedar. Because the market for this wood has been good for a long time, the forests have been cut frequently. The cedars have water constantly available, except in severe droughts, because the water table is at or near the surface of the Muck 10 to 12 months of the year. Because of this water table, the cedars develop a shallow root system and are severely subject to windthrow.

THE TIDAL MARSH ASSOCIATION

This soil consists of high organic silt flats near sea level, where they are flooded twice daily. The soil material is brownish and has an average thickness of about 3 feet. It is 10 feet or more thick in many places and is as little as 1 foot thick in some places. Below the layers of silt are sand and gravel and, in some places, clay.

Marsh, tidal, is most extensive at the mouths of the Mullica, Bass, and Wading Rivers in the southeastern part of the county. Here the waters generally are brackish. Methane or marsh gas forms in many places.

The native vegetation is salt-tolerant grasses and sedges. Salt hay formerly was harvested but little is harvested now. Numerous buried logs and stumps were uncovered in a tributary of the Bass River west of Route 9 when the channel was deepened. These logs and stumps indicate that the vegetation may once have been forest.

The descriptions of the soil associations have been adapted from Soil Survey of Burlington County, New Jersey, U.S. Soil Conservation Service in corporation with the N.J. Agricultural Experiment Station, published by the U.S. Department of Agriculture, 1971.

Construction and Drainage Characteristics of Bass River Township Soils

The following data have been selected and reproduced from the Soil Survey of Burlington County, New Jersey, U.S. Soil Conservation Service in corporation with the N.J. Agricultural Experiment Station, published by the U.S. Department of Agriculture, 1971.

Soil Type and Map Symbol	Soil features affecting foundations for low buildings	Drainage	Disposal of septic effluent
Alluvial land, sandy:	Subject to stream overflow; seasonal water table high	Subject to stream overflow	Severe: subject to stream overflow; seasonal water table high and does not drop much in summer.
Atsion sand:	Seasonal water table high; good shear strength.	Moderately rapid permeability, suitable for drainage if water table is controlled.	Severe: seasonal water table high.
Downer loamy sand:	Shear strength good	Not applicable or not needed.	Slight
Evesboro sand	Shear strength good	Not applicable or not needed.	Slight; strong slopes.
Lakehurst sand	Seasonal water table moderately high; shear strength fair to good.	Not applicable or not needed.	Moderate: a seasonal water table moderately high; needs drainage.
Lakewood sand	Shear strength fair to good	Not applicable or not needed.	Slight
Muck, shallow	Unstable material; seasonal water table high.	Not applicable or not needed.	Severe: seasonal water table high, does not drop much in summer.
Sassafras fine sandy loam	Shear strength good to fair in subsoil, good in substratum.	Not applicable or not needed.	Slight
Woodmansie sand	Shear strength good	Not applicable or not needed.	Slight
Woodstown loamy sand	Seasonal water table moderately high; shear strength of substratum good	Seasonal water table moderately high, permeability moderately slow or moderate in subsoil, moderate or moderately rapid in substratum.	Moderate: seasonal water table moderately high; needs drainage.

Limitations of Soil for			
Streets and parking lots	Athletic fields	Parks and playgrounds	Sanitary Land Fills
Severe: subject to stream overflow; seasonal water table high.	Severe: subject to stream overflow; seasonal water table high.	Moderate: subject to stream overflow; seasonal water table high.	Severe: subject to stream overflow; seasonal water table.
Severe: seasonal water table high.	Severe: seasonal water table high; loose sand texture.	Moderate: seasonal water table high.	Severe: seasonal water table high.
Slight	Moderate: low fertility; low available water capacity; loose consistence.	Moderate: loose sandy surface.	Severe: filter material limited.
Slight for streets, moderate for parking lots; strong slopes.	Severe: very low available water capacity; low fertility; loose consistence.	Severe: loose sand	Severe: filter material limited.
Moderate: seasonal water table moderately high; loose sand.	Severe: very low fertility. very low available water capacity.	Moderate: loose sandy soil.	Severe: seasonal water table moderately high.
Slight	Severe: very low fertility; very low available water capacity.	Moderate: loose sand	Severe: filter material limited.
Severe: seasonal water table high; severe subsidence.	Severe: seasonal water table high.	Severe: seasonal water table high.	Severe: seasonal water table high.
Moderate: frost-action potential.	Slight	Slight	Slight: filter material may be limited.
Slight, water erosion hazard	Severe: very low fertility; low available water capacity.	Moderate for parks; severe for playgrounds: loose sand at surface.	Slight: filter material may be limited.
Severe, seasonal water table moderately high; frost-action potential high.	Moderate: seasonal water table moderately high.	Slight	Severe: seasonal water table moderately high.

SOILS AND THE GROUND WATER TABLE

The soils of Bass River Township vary in their retention of ground water. The accompanying map indicates the soils of the township with a color-coded distinction for each of the three following categories. (See figure 3).

1. Ground water level at a depth of five feet or more in all seasons of the year.
2. Ground water at a depth of two feet in winter and spring and receding to a depth of no more than five feet in summer and autumn.
3. Ground water at the surface in winter and spring and no more than a depth of three feet in summer and autumn.

A series of twenty test holes of 6" in diameter has been drilled to verify these generalized soil-water area designations.

The soil-water levels are being monitored one or more times per month for a period of at least one year beginning in February, 1974. Particular attention is being paid to developing correlations between streambed levels and elevations above each streambed.

A list of the locations of soil-water test holes follows with a table of ground water holes recorded.

A log of soil materials was made as the water test holes were drilled with a 6" diameter bucket auger. The generalized soil profiles found in the Soil Survey of Burlington County were verified in all cases. Hole no. 22, in the lower or east plains area of the Township, exhibited a clay layer from the 20" level to the 90" level at which water under artesian conditions was encountered. Such a clay layer represents an extreme example for loamy phases of soil formations like the Downer series.

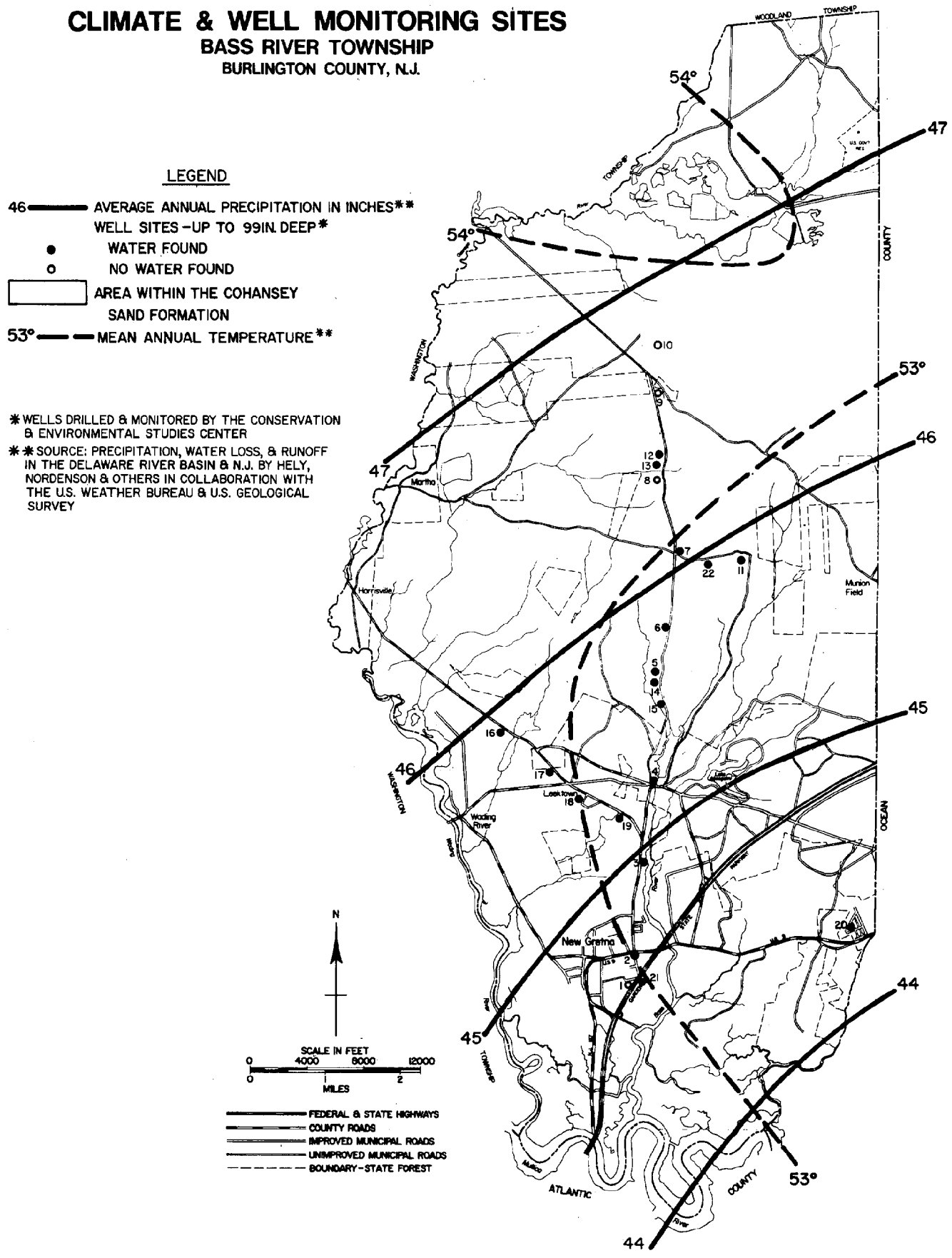
The monitoring of water table levels will be continued using the test holes so that an annual regime of ground water fluctuations will have been measured directly. The Environmental Commission and other residents of the Township will collect these data.

FIGURE 2

CLIMATE & WELL MONITORING SITES

BASS RIVER TOWNSHIP

BURLINGTON COUNTY, N.J.



Bass River Township Environmental Inventory

Ground Water Survey

Hole Sites

1. Junction of South Maple Avenue and Cramer Road. Beyond wooden road fence (guard rail) in a line 166° true north reading from utility pole and road sign. In ground 5'. No water found.

2. South Maple Avenue and U.S. Route 9. 3 feet North of utility pole at edge of parking lot of Bass River Township Branch of People's National Bank. Water 41" below surface.

3. N. Maple Avenue, Dr. Suckling's property. 1.2 mile N. Route 9 — 40' South Side Drive. Dr. Suckling's driveway about 20' east of road. Water - 66½" below surface.

4. Allen Coal Rd. Middle of road, in front of Pilgrim Lake, exit road. Bearing 268° - 100 ft. 5 ft. deep, water at 4', pipe in middle of ink berry patch. Yellow can top.

5. 0.2 mile North of Barlett's Bridge — West Branch of Bass River about one mile north of no. 4 azimuth 250° past old small litter dump (85' - 90').
Pipe in 72" - no water found.

6. One mile north of no. 5. 325 ft. before peak of rise in road. Bearing 290°, 100 ft. from middle of road - blaze on pine tree behind 2 ft. high pitch pine clump, at bottom 5½ ft. deep. Water 64" below surface.

7. 1.2 mile N. no. 6 - N. Oswego Road "Patrolled" sign at right side at 400' mark 410' N. on Allen Road from Oswego Rd. 85' - azimuth 287°. No water found.

8. One mile north no. 7 - small bulldozed area on left. Sand - gravel 100' from road edge, up hillside. Bearing 238° from double blazed tree. 5½' dry. No water found.

9. Two miles North Oswego Rd. "Patrolled" sign 95° - azimuth 75' from tree. Pipe in 48". Water level - 34½" below surface.

10. One mile N. of no. 9, opposite large clearing 100 ft. from middle of road. Bearing 64° 10 yd. N.W. of bulldozed area. 5ft. 6in deep - no water found.

11. Oswego Road, 1.1 miles east of Allen Road. Located on south side of Oswego Road, azimuth 180 degrees from pine with attached "Patrol" sign. Test hole is 90' from road. Water 47" below surface.

12. and 13. — Both located at an azimuth of 298° from Allen Road, beginning fifty feet north of the crossing of the Beaver Branch of the Oswego River. Holes are located at a distance of 140 feet from Allen Road, within 25 feet of each other; no. 12 is upward on a south facing slope. Water at 85" below surface in no. 12 and 57" below in no. 13.

14. Allen Road north of Bartlett's Branch, West Branch of Bass River. Location about 750 feet north of Bartlett's Branch, on west side of Allen Road, 120 feet from road, azimuth 270 degrees. Water at 43½" depth.

15. Allen Road 442 feet north of Bridge on Bartlett's Branch. The hole is 75 feet from road, azimuth 270 degrees. Water at 37.5" depth.

16. Chatsworth Road - just south of the four mile marker, and north of Timberline Lake. Hole is about 100 feet from road, azimuth 250 degrees. Water at 44" depth.

17. Chatsworth Rd. - Rt. 563 - N. of 3 mile mark (N. Leektown) 130' N of utility pole N of 3 mile mark. South Side Rd. - "No Hunting" sign on White Oak tree. Home and driveway opposite. Azimuth of 285° from sign. (True N) Hole 72½" deep - no water found.

18. South side of Rt. 563 - dirt road just north of entrance to Merrygold Estates, 0.1 mile (in) south side Rt. 563 at T intersection. Take right side inside of curve 360° 50' pipe in 50 ft. Old red can covering pipe - water approximately 52" below surface.

19. Logging Road south side Rt. 563 about 0.1 mile N of 2 mile mark. In 350' south, road forks. Follow compass line of road 50' in pine grove to hole 56½" in ground with green cap. Water 37" below surface.

20. Offshore Manor - Cedar Ave. rear of house of John Monaco Pipe in 5' - no water found.

21. South side of Garden State Parkway, at the foot of Maple Avenue. Test hole is about 150 feet from parkway in an abandoned orchard, on a slope toward an abandoned gravel pit. Water at 51" depth.

22. Oswego Road - 0.5 mile east of Allen Road. A small road leads south from this low point in the "lower plains"; there is a broken gate which formerly controlled access. Test site is 57 feet from gate on the westerly side of road. Soil log does not correspond exactly with the profile indicated in the Burlington County Soil Survey. Clay layers underlying this site are more than seven feet in thickness, although the soil log does refer to a loamy substratum, sometimes of clay 30 or 40 to 60" below the surface. Water at 80" depth.

Environmental Inventory

Bass River Township

Station Micro-Climate Report Sheet

Table to Show Level of Ground Water Below Surface (Inches)

1974

Hole	Hole Depth	2/7	2/10	2/14	2/21	2/28	3/7	3/10	3/14	3/17	3/21	3/27	3/30
1	57"				> 57	> 57	> 57	>57	> 57	*			
2	57"						19.5	NR	40	34	32.5A 36.5P	31	29.25
3	67"						66	NR	67	64	66	61	NR
4	52"						31	NR	35.5	32	27	27.5	NR
5	67"						67	67	67	67	67	64	
6	64"					52	64	64	64	64	64	61	62.5
7	68"			>68	>68	NR	> 68	> 68	> 68	> 68	67	67	67
8	66"				> 66	>66	> 66	> 66	>66	> 66	> 66	>66	*
9	43"						20	NR	24	13	NR	16	12.75
10	66"				> 66	> 66	> 66	>66	> 66	>66	>66	> 66	*
11	52"	Placed new hole		3/14					47	NR	44	42	NR
12	88"	Placed new hole		3/7				86	85	84	NR	82	79.75
13	59"	Placed new hole		3/7				57	58.5	57	NR	57	55
14	60"					43.5	47	46.5	45	48	NR	41	NR
15	44"					37.5	37	36	36	30	32	30.25	NR
16	59"						44	NR	44	NR	45	40.25	NR
17	72½/91	Hole drilled to new depth			3/21/74		>72.5	> 72.5	> 72.5	NR	>72.5	89	NR
18	64"						46	NR	44	NR	44	41	NR
19	49"						21	NR	19	NR	18	16.5	NR
20	60/73	Hole drilled to new depth			3/21/74		>60	> 60	> 60	> 60	65	57	NR
21	53"								51	NR	41	39.25	NR
22	99"	Drilled new hole		3/27/74								80	52.25

NR = No Reading

*Pipe removed this date. No ground water measured.
Ground water level below hole depth is assumed to be present.

Bass River Township

Station Micro-Climate Report Sheet

Table to Show Level of Ground Water Below Surface (Inches)

1974

Hole	Hole Depth	4/4	4/11	4/16	4/22	5/9
1	57"	–	–	–	–	–
2	57"	18	22.5	22.5	30	39
3	67"	58	54.5	59.5	62.25	67
4	52"	22.5	22.25	23.25	26	35
5	67"	62.5	60.75	63	66	67
6	64"	56.5	51.5	54	57.5	64
7	68"	67.5	67.5	66.5	68	68
8	66"	–	–	–	–	–
9	43"	13.5	7	10	NR	19
10	66"	–	–	–	–	–
11	52"	42	42.25	43	NR	55.75
12	88"	81.25	80	79	80	85
13	59"	53.5	54	53.25	53.25	57.5
14	60"	39	37	34.75	39.50	46
15	44"	25	23	38	NR	36.5
16	59"	42.75	34.5	37	39.5	34.75
17	91"	77.5	76.25	74.5	78.5	83
18	64"	38	33	33	38	44
19	49"	11.25	11.25	13.75	17.5	21.5
20	73"	59.5	53	54.75	58.5	73
21	53"	36.25	30	38	41	42.5
22	99"	46	39	42	48	61.5

NR = No Reading

FIGURE 3

SOIL RESOURCE MAP

BASS RIVER TOWNSHIP

Water table generally remains 5 feet or deeper from ground surface all year.

Water table generally fluctuates from 2 feet (in winter-spring) to 5 feet (in summer-fall).

Water table generally fluctuates from ground surface (in winter-spring) to 3 feet (in summer-fall).

prepared by
the
BURLINGTON COUNTY
SOIL CONSERVATION DISTRICT
Source Burlington County Soil Survey Report
U.S.D.A. Soil Conservation Service

INTERPRETATION

The ground water level is relatively high in most parts of Bass River Township, with some exceptions at upper (northern) elevations. During the wet winter and spring seasons, ground water levels throughout most of the Township may be found at levels from two to six feet below the surface. This high level diminishes during the more droughty summer and fall seasons until frost reduces evapotranspiration losses from plant activity. Exceptions might be found on sandy hills of relatively steep slope.

During the spring of 1974, heavy rains in late March and early April apparently produced a rapidly rising water table.

The accompanying map was prepared by the Burlington County Soil Conservation District from data included in soils descriptions found in the Burlington County Soil Survey provided by the Soil Conservation Service of the United States Department of Agriculture. The findings of the ground water testing program are consistent with these generalized soil data. (See Figure 3)

The New Gretna village area appears to be fairly well drained in general. Black-topped areas together with soil areas compacted by vehicles or extensive use produce areas with standing surface water. One such area near the intersection of U.S. Route 9 and N. Maple Avenue appears to have the problem compounded by the closure of the original drainage ways. Test hole no. 2, located in town immediately adjacent to a small parking lot with a black topped apron showed higher and more rapid fluctuations related to rainfall.

For areas where any extensive black topping is projected, drainage ways for the rapid run off toward easily saturated soils must be provided to prevent standing water.

Two other factors are of great significance in future planning for the township. First, the northern more elevated section of the township has many "dry" areas. But many of these have locally wet areas apparently produced by water perched above a clay layer found at relatively shallow depths. This means that ground water tests and adequate percolation test need to be made at each individual site proposed for development. No overall categorization of the water table may be accurately projected from existing data.

Second, there are several areas of manmade land, along U.S. Route 9 and off unimproved roads in the tidal marsh areas. Since most of these materials are from dredging spoils, they will have the characteristics of the Atsion-alluvial land, sandy – muck association combined with those of the Tidal Marsh association. Their permeability is low and their water retention capacity is high. Buildings proposed for such sites must have off-site sewage disposal facilities to prevent soil and surface water contamination.

Chapter 4 – RIVERS, WATER SUPPLIES AND AQUIFERS

RIVERS

Bass River Township is bounded on the north and west by streams of the Wading River complex. Reference to the map shows the northwestern boundary formed by the Papoose Branch of the Oswego River and the Oswego River, itself a tributary of the Wading River. The Bass River which gives the township its name, drains most of the township's area with the exception of the northwest areas as described previously and the southeast area.

In the southeast sector of the Township, two smaller streams - Job's Creek and Bellanger (Bellangy) Creek drain directly into Great Bay.

WATER QUALITY

The water of all of these streams is of high quality. Field data on water quality collected in April, 1974 was consistent with data maintained by the N.J. Department of Environmental Protection during 1973.

A summary of these data is reproduced here.

These data show that the waters of the township are of exceptionally high quality. The streams drain lands of essentially sandy composition. Such earth materials tend to be low in all mineral materials as solvents. The acidity is relatively high (a lower than the common 5 - 7 pH value). This condition is found throughout all of the pinelands, influenced both by the sand (acid) soils and by decomposition in intermittent ponds and cedar or hardwood swamps.

The relatively high coliform organism readings at two stations (1 and 8) are attributed to the presence of wild ducks. Both are shallow ponds, one intermittent in water table (5) above the surface, the other subject to tidal fluctuations (1).

These reports indicate a high water quality in Bass River Township's present environment, a condition consistent with and necessary for present and projected land use.

SUMMARY REPORT SHEET

Water Quality

Date: April 4, 1974

Sampling Station	Temp.	Odor	Acidity pH	Dissolved Oxygen O_2 ppm	Ortho Phosphate PO_4 ppm	Nitrate NO_3 ppm	Coliform Bacteria MPN/100 ml
1	60	Slight Swampy	4.5	10	< 5	< 5	9000
2	52	Slight Medicinal	5.0	9	< 5	< 5	0
3	50	Slight Aromatic	5.0	8	8	3	100
4	57	Aromatic	4.5	8	0.5	1	300
5	54	None	4.8	8	5	0.2	0
6	52	None	4.5	9	1	0.1	0
7	50	None	4.5	9	0.9	0.4	0
8	55	None	4.5	9	0.3	< 0.1	500
9	60	Aromatic	5.0	10	0.8	< 0.1	300
10	71	Aromatic	4.5	9	0.4	< 0.1	0
11	55	Aromatic	4.5	8	0.3	< 0.1	0
12	55	Aromatic	4.5	9	0.4	< 0.1	0

WATER QUALITY DATA OF THE BASS RIVER*

Dates	Coliforms MPN/100 mL	Color (units)	Turbidity (units)	Suspended Solids mg/l	Total Solids mg/ l	Total Phos-phate mg/l	Nitrates mg/ l	pH (units)	Field D.O. mg/l	Temp $O^{o}C$
12/4/72	22	Brownish	7	14	2046	.04	0	6.3	9.5	5^{o}
1/31/73	33		7	14	866	0	0	5.7	10.8	0^{o}
4/9/73	49	Brownish	5	16	222	.5	0	6.0	6.3	7^{o}
6/21/73	920	" "	4	8	2994	.2	0	5.5	6.8	20^{o}
10/9/73	240		5	14	13038	.4	0	6.0	6.2	10^{o}
1/7/74	13		7	12	312	.5	0	6.8	10.9	1^{o}

*Data from Bureau of Water Pollution, Division of Water Resources, N.J. Department of Environmental Protection

SURFACE WATER QUALITY CLASSIFICATION

The Department of Environmental Protection for the State of New Jersey has classified all of the waters of the state with respect to quality standards.

Fresh Water

Fresh waters, including rivers, streams, lakes, or other bodies of water, that because of their clarity, color, scenic setting, or other characteristic of aesthetic value or unique special interest, have been designated by authorized State agencies in conformance with laws pertaining to the use of private lands, are set aside for posterity to represent the natural aquatic environment and its associated biota.*

*Rules and Regulations Establishing Surface Water Quality Criteria, N.J. Department of Environmental Protection, June 30, 1971.

There are no waters classified FW-1 in Bass River Township. Although most of the surface streams in the Township meet the criteria for this classification, the Department of Environmental Protection maintains the following policy:

Waters having the potential for the Class but which are not classified as such at this time may be recommended for such classification by public or private interests controlling the land area draining to the watercourse. Because of the restrictive-use nature of the FW-1 classification any waters thus designated must be contiguous with their source. Also, since the characteristics of surface waters are sometimes changed to the detriment of their natural biota by seemingly minor associations with domestic and/or agricultural activities, they must be inspected and approved before being classified.

This restriction prevents many streams from receiving this classification. If the Environmental Commission and the Planning Board of Bass River Township can obtain land use guaranties for streams rising on private lands, then the FW-1 classification may be applied for . Further, if new public land acquisitions for the State of New Jersey are made within the Township, then some stream sources may fall within those new boundaries, and a reclassification application may be made.

The fresh water streams of Bass River Township upstream from the head of tide are classified as FW-2. The FW-2 class waters must meet the following requirements.

Class FW-2 — Fresh surface waters approved as sources of public water supply. These waters shall be suitable for public potable water supply after such treatment as shall be required by the Department.

These waters shall also be suitable for the maintenance, migration and propagation of the natural and established biota; and for primary contact recreation; industrial and agricultural water supply and any other reasonable uses.

3.2.1 Floating Solids, Settleable Solids, Oil, Grease, Color and Turbidity

None noticeable in the water or deposited along the shore or on the aquatic substrata in quantities detrimental to the natural biota. None which would render the waters unsuitable for the designated uses.

3.2.2 Toxic or Deleterious Substances Including But Not Limited to Mineral Acids, Caustic Alkali, Cyanides, Heavy Metals, Carbon Dioxide, Ammonia or Ammonium Compounds, Chlorine, Phenols, Pesticides, Etc.

None, either alone or in combination with other substances, in such concentrations as to affect humans or be detrimental to the natural aquatic biota or which would render the waters unsuitable for the designated uses. None which would cause the Potable Water Standards of the Department for drinking water to be exceeded after appropriate treatment.

3.2.3 Taste and Odor Producing Substances

None offensive to humans or which would produce offensive tastes and/or odors in water supplies and fauna used for human consumption. None which would render the waters unsuitable for the designated uses.

3.2.4 pH

Between 6.5 and 8.5

3.2.5 Dissolved Oxygen

(a) Trout Production Waters - Not less than 7.0 mg/1 at any time.
(b) Trout Maintenance Streams - Daily average not less than 6.0 mg/1. Not less than 5.0 mg/1 at any time.
(c) Trout Maintenance Lakes - Daily average not less than 6.0 mg/1. Not less than 5.0 mg/1 at any time.

In eutrophic lakes when stratification is present, not less than 4.0 mg/1 in or above the thermocline where water temperatures are below 72°F. At depths where the water is 72° F. or above, daily average not less than 6.0 mg/1 and not less than 5.0 mg/1 at any time.

(d) Nontrout Waters - Daily average not less than 5.0 mg/1. Not less than 4.0 mg/1 at any time.

3.2.6 Temperature

(a) Trout Production Waters - Natural temperatures shall prevail except where properly treated wastewater effluents may be discharged. Where such discharges occur, stream temperatures shall not be raised more than 1°F.

(b) Trout Maintenance Streams - No heat may be added which would cause temperatures to exceed 2°F. over the natural temperatures at any time or which would cause temperatures in excess of 68°F.

Reductions in temperatures may be permitted where it can be shown that trout will benefit without detriment to other designated water uses. The rate of temperature change in designated mixing zones shall not cause mortality of the biota.

(c) Trout Maintenance Lakes - No thermal alterations except where it can be shown to benefit the designated uses.

(d) Nontrout Waters - No thermal alterations, except in designated mixing zones which would cause temperatures to deviate more than 5^{o}F. at any time from natural stream temperatures or more than 3^{o}F. in the epilimnion of lakes and other standing waters.

No heat may be added, except in designated mixing zones, which would cause temperatures to exceed 82^{o}F. for small mouth bass or yellow perch waters or 86^{o} F. for other nontrout waters.

The rate of temperature change in designated mixing zones shall not cause mortality of the biota.

3.2.7 Radioactivity

Current U.S. Public Health Service Drinking Water Standards shall apply.

3.2.8 Bacterial Quality

Fecal coliform levels shall not exceed a geometric mean of 200/100 ml. Samples shall be obtained at sufficient frequencies and at locations and during periods which will permit valid interpretation of laboratory analyses.

Appropriate sanitary surveys shall also be carried out as a supplement to such sampling and laboratory analyses.

The surface waters of the Township which are subject to tidal action are classified TW-1. The criteria for this classification are nearly identical to those for the FW-2 classification. In other words, the standards for surface waters in the Township are, for all practical considerations, identical. The chief exception is the omission of criteria for temperature and dissolved oxygen in trout production waters and lakes in the tidal water class. (Trout are not produced in tidal waters.)

AQUIFERS

Several adequate aquifers have been identified in chapter 3 in the discussion of geological formations. It is safe to say that any well sunk to the aquifers of the Kirkwood, Mount Laurel - Wenonah or Raritan - Magothy foundations would yield water of excellent quality in abundant quantity. It is probably true that many of the residential water supplies are shallow wells penetrating the ground water levels between 3 and 15 feet depth. This practice will be satisfactory except in cases of pollution from on-site septic systems or in cases of extreme drought. The abundant safe sources of water from deeper strata are recommended for use by water consumers in the township.

GENERAL HYDRAULIC CONDITIONS

A great deal of ground water under "water table conditions" is available in the township due to the large highly porous unconsolidated surficial deposits of the township. The sediments however, vary greatly in their ability to store and transmit water. Generally sand and gravel transmit and store water much better than finer-grained sands, silt, and clay.

Most ground water in the area comes from precipitation. The fresh water is generally of good to excellent chemical quality with the exception of the high iron concentrations. Near saline surface water the ground water is brackish.

Annual precipitation in the area is 44" to 48". The minimum precipitation statistic may be analyzed further. Of this precipitation, 23" to 24" is lost for recharging ground water. This loss is due to direct evaporation and to evapotranspiration by plants. The remaining 20" to 21" of potential runoff or recharge. Some of this groundwater becomes the aquifer recharge. This "runoff" has two aspects (1) surface runoff and (2) subsurface runoff (flow of groundwater) below and between stream channels. This 20" to 21" of runoff is not completely utilized to recharge the groundwater supplies since most of the formation is already saturated with water.

Water levels are generally highest during the winter and early spring and begin to decline at the start of the growing season, dropping until the first killing frost. Plant growth induces the groundwater table decline. This represents a loss of stored water. Water demand is thus highest in the summer season.

GLOSSARY

Aquifer – A water bearing formation of rock, sand, or clay. It may be overlain and underlain by impervious formations; in which case it is a *confined aquifer.* The absence of one or both of the impervious beds produces an *unconfined aquifer.* An unconfined aquifer is often under watertable conditions.

Artesian Water – The water from a confined aquifer, is under pressure and in some cases will flow to the surface without the aid of a pump when a well reaches an artesian formation.

Coefficient of Transmissability -- Is the rate of flow of water in gallons per day through a vertical strip extending the full saturated thickness of the aquifer under a unit hydraulic gradient at 60 degrees F.

Coefficient of Storage -- Is the volume of water released from or taken into storage per unit surface area per unit change in component of the head normal to that surface.

Confining Beds -- Impervious beds which overlie or underlie a water bearing formation.

Specific Capacity (of a well) -- The rate of yield per unit of drawdown, generally expressed in gallons per minute per foot. Over 40 gpm/ft. is excellent. Specific capacity is related to permeability and transmissability.

COHANSEY FORMATION

Location

The Cohansey "Sands" Formation is the most important aquifer in the township. Most domestic wells are placed in this formation. It is used extensively for domestic wells in the southeastern half of Burlington County.

This formation outcrops in the southeastern half of the county for a total outcrop area of 380 sq. miles or 46% of the county. The outcrop area is that area where the formation is at the surface. Outcrop areas are, therefore, the primary recharge areas of any aquifer.

Lithology

Sedimentary characteristics of the formation are light gray to yellowish brown, medium to coarse grained pebbly quartz sand with local kaolinitic (clay) beds in the upper part of the formation. Some pebbles in the formation are up to 4 inches in diameter. Common horizontal stratification is a characteristic feature. The beds that are water bearing lie at 55' and 100' depths at an Oswego Lake test well. These two beds are of coarse-grain quartz sand, they are overlain by an essentially silty, fine to medium grained quartz. The two coarse grained beds are separated by 15' of silty sand. The formation is 175' thick at this site. The formation never exceeds a thickness of 250' in the township.

The Cohansey Formation unconformably overlies the Kirkwood Formation. The Beacon Hill or the Bridgeton Formations overlie the Cohansey only as a cap on the highest hills and are commonly undurated with iron-oxide. The presence of a few marine fossils indicates that these are freshwater deposits.

Log of a Typical Well in the Cohansey Formation

Well no. 61, Harrisville
(Log by Mahlon Broon)

	Altitude 15 feet	
Tertiary:	Layer Depth	Accumulated Depth
Cohansey Sand:		
Sand	77	77
Sand	8	85
Blue mud	13	98
Clay (with pyrite?)	10	108
Marly mud	16	124
Strata with wood (?)	7	131
Mud with shells	15	146
Hard sediments	50	196
Water-bearing sand	35	231
Dark, slushy sand	14	245
Yellow sand	16	261
Coarse, red sand	45	306
Dark sand	12	318
White clay	13	331
Kirkwood Formation:		
Water-bearing, green marl	37	368
Slate stone (?)	7	375

Smock, 1893, p. 288-289

Hydrologic Characteristics

The Cohansey Formation is an important aquifer in the county. There are no overlying confining beds, so most of the formation is under "water-table conditions". Test results at several test wells show a Coefficient of Transmissability at 130 gpd/sq. ft. at Coyle Airport and 86 gpd/sq. ft. at Oswego Lake; a coefficient of permeability at 28,000 gpd/ft. and 15,000 gpd/ft. have been measured at other locations. This indicates a fair to good ability to yield water. An aquifer test in the Wharton Tract obtained much higher results. The Coefficient of Transmissability was 150,000 gpd/sq. ft. and the Coefficient of Permeability of 1,000 gpd/ft.

Total county pumpage is estimated at 579,000 gpd, primarily by domestic wells. This is 2.3% of total available pumpage. Thus the Cohansey is not completely utilized at this time.

Water enters the aquifer from precipitation in all exposed high areas and moves toward low-level areas where it is ultimately discharged into Rancocas Creek, the Mullica, Wading and Bass Rivers. The annual potential recharge available is 558 million gallons per day. This figure is an estimate based on the statistic of 21" of runoff annually available for recharge and potential subsurface runoff over the 380 square mile recharge area. However because the superficial soil layers quickly reach saturation

during storms, much of this potential recharge is lost to the streams through overland flow (surface runoff) during these storms.

Water Quality

Water quality is good except for a high iron concentration (in the range of 5-49 parts per million). The water is basically soft with a hardness in the range of 2-48 parts per million with an average of 15 ppm. Chloride or salt contaimination is not present in the Green Bank-New Gretna area since analysis indicates an average of only 10 ppm. Salt water contamination can be expected in those marshy areas near Great Bay.

KIRKWOOD FORMATION

Location

The Kirkwood Formation crops out in an irregularly bounded belt southeast of the Manasquan, the Vincentown and Hornerstown Formations and generally extending in a northeast to southwest direction. The outcrop area in Burlington County is 110 square miles.

Lithology

The Kirkwood is divided into two units at the outcrop area. The upper unit consists of brownish black clayey silt to very fine grained quartz sand. A thicker lower unit is made up of light-gray to light yellow orange very fine to fine grained quartz sand. However, logs of the test well sites in Oswego Lake and Bass River Township show the formation to be divided into three units. The lower unit consists of olive-gray very sand silt, the middle unit is light gray to yellowish orange coarse-grained quartz snad and gravel. The upper unit is light-gray very silty sand. The formation thickens to the southeast. It is 50' thick at its surface outcrop belt in the northwest while its thickness is 285' at Oswego Lake and 250' at Harrisville.

The Kirkwood unconformably overlies the Hornerstown and Vincentown Sands, and the Manasquan Formation. Fossils and glauconite indicate that this formation is of marine origin.

Hydrologic Characteristics

This formation is of minor importance as an aquifer in Burlington County. It is only used by small diameter wells for domestic supply in the central part of the county. The Kirkwood is overlain by the Cohansey Sands which are utilized more because of their shallower depth. A laboratory analysis at Oswego Lake and one at Coyle Airport indicated a great ability to transmit water. Recharge for the formation comes from two sources: (1) percolation at the surface outcrop belt and (2) percolation from the overlying Cohansey Formation. There have never been any aquifer tests of the Kirkwood in Burlington County. However, tests done at Ancora State Hospital showed a Coefficient of Transmissability of only 10,500 gpd/ft. and a Coefficient of Permeability of 170 gpd/ft. East of this location the formation is much more usable due to a Coefficient of Transmissability of 130,000 gpd/ft.

Total pumpage from the Kirkwood in Burlington County is estimated at 63,000 gpd or about .25% of the available pumpage. Because transmissibility is poor near the outcrop belt, the Wenonah Formation and Mount Laurel Formation are used in this area. The increased transmissability in the area of the township and limited pumpage from the formation indicate that the Kirkwood formation is capable of extensive development.

Water Quality

Chemical quality of the Kirkwood water is generally excellent. There are high concentrations of iron, but the iron concentration does not exceed 29 ppm in any test wells. The water is generally soft with an average hardness at 60 ppm. Samples taken in test wells by the United States Geodetic Survey does not indicate chloride concentrations over 4 ppm. This indicates no saline water contamination although areas close to brackish and saline water are susceptible to contamination.

THE MAGOTHY–RARITAN FORMATION

Location

The Raritan and Magothy Formation is the most important aquifer in the county. Its outcrop area is a two mile wide belt southeast of the Delaware River; its extent in Burlington County is 48 square miles.

Lithology

The Raritan is light gray to white cross stratified, medium to coarse grained quartz sand and white to red varigated clays. The Magothy is similar but contains more clay. The formation thickens to over 600' in the Bass River area, however it is less sandy. A well was driven by Transcontinental Pipe Line Company in 1951 in Bass River that went to this formation. This well penetrates to 1648' to enter the formation.

Hydrologic Characteristics

The water bearing zones are variable within short distances and are sometimes only a few feet thick. Wells producing 1,000 to 1,500 gpm are common in the northwest part of the county. Aquifer tests near areas of heavy pumpage put the coefficient of transmissability from 46,000 to 513,000 gpd/ft.; coefficient of permeability ranges from 1,000 to 2,170 gpd/sq. ft. These figures show the variable zones in the aquifer. The higher figures represent areas where large diameter wells could be used.

Recharge comes from precipitation on high level intake areas in Middlesex County. Heavy pumping has caused some reversal of flow in the aquifer but recharge from the basin of the Delaware River stabilizes the stored water in the formation. The river water after penetrating the formation is generally of satisfactory quality. Over pumping in coastal zones could cause salt water encroachment of the aquifer which would adversely affect water in Bass River in this formation more quickly than areas to the north and west of the township. It is estimated that the aquifer potential is 62 million gallons per day; only 20 million gpd are estimated to be currently used.

This formation is a potential water resource for Bass River Township but the formation lies at such a great depth that the cost would probably be prohibitive.

ENGLISHTOWN FORMATION

Location and Lithology

This formation outcrops southwest of Rancocas Creek and has an area in the county of 63 square miles. Composition is generally a light gray to white micacious, lignitic, fine grained quartz sand. Further downdip clay beds rather than sand make up much of the formation.

Hydrologic Characteristics

The Englishtown Formation is commonly tapped for minor water supplies. Thickness reaches a maximum of 60 ft. Sand beds of the formation are poorly developed making large amounts of water in a specific area impossible. Low transmissability of the formation requires a wide distribution of moderate and low capacity wells.

Recharge comes primarily from vertical leakage from the overlying Marshaltown Formation. Estimated recharge is 12.3 mgd. Only 1.3 mgd are estimated to be pumped at this time in Burlington County.

Water Quality

Water quality is generally fair to good. There are high iron concentrations and hardness in parts of the formation is also high.

SUMMARY

(1) The Cohansey Formation is the most exploitable ground water resource for Bass River Township. This is because of its closeness to the surface (thus reducing well installation and maintenance cost). High transmissability, high water yielding potential, and good water quality are all advantages in utilizing water from this formation.

(2) Steps should be taken to protect the quantity and quality of ground water from the Cohansey Formation. Thus excessive pumping of the formation in areas near sea level should be controlled to avoid salt water incursion. Landfills should not be planned up-slope from domestic wells. Excessive paving or timber harvesting of upland areas should be avoided in order to preserve the access of rain water to the Cohansey and other aquifers. The inner uplands of the Pine Barrens absorb the water which is utilized by the people and industry of eastern Burlington County and Bass River Township in particular.

(3) Finally, the water commissions, sewerage authorities and planning boards of Bass River Township and its neighbors should meet with each other in order to protect their ground water resources. One township cannot provide such protection without the participation of the surrounding townships, as they all shre the central recharge area and they all can affect each others water supplies.

Summary of the geologic formations and their hydrologic characteristics

System	Series	Formation	Symbol	Thickness	Lithology	Hydrologic Characteristics
Quaternary	Recent	Alluvium and eolian sand	Qual	0 - (?)	Clay, silt, and sand	Too thin to be tapped for water
	Pleistocene	Cape May	Qcm	0 - 40		Usually hydraulically connected with overlain aquifers to increase the saturation thickness
		Pennsauken	Qps	0 - 40		
		Bridgeton	Qbr	0 - 40		
Tertiary	Pliocene (?)	Beacon Hill	Tbh	0 - 10	Gravel	Too thin to be tapped for water.
	Pliocene (?) and Miocene (?)	Cohansey Sand	Tch	0 - 365	Coarse grained sand and sandy silt.	Variable ability to store and yield water.
	Miocene	Kirkwood	Tkw	0 - 300	Very fine to coarse grained sand.	
	Eocene	Manasquan	Tmq	0 - 150	Clayey, fine grained glauconite; quartz sand.	Excellent to poor ability to yield water.
		Vincentown	Tvt	0 - 200	Clayey calcarenite and clayey, glauconitic, quartz sand	
	Palocene	Hornerstown Sand	Tht	0 - 80		These formations function as confining beds.
Cretaceous		Red Bank Sand	Krb	0 - 50	Clayey glauconite sand.	
		Navesink	Kns	0 - 40		
		Mt. Laurel Sand	Knw	0 - 110	Silt and medium grained sand.	Good ability to store and yield water.
		Wenonah Marshalltown	Kmt	0 - 45	Glauconitic, quartz sandy clay.	Confining bed.
		Englishtown Sand	Ket	0 - 80	Fine to medium grained quartz sand and clay	Good to poor ability to yield water.
		Woodbury Clay	Kwb	0 - 80		These formations function as confining beds.

System	Series	Formation	Symbol	Thickness	Lithology	Hydrologic Characteristics
Cretaceous		Merchantville Magothy	Kmv	0 - 100	Clay Med. to coarse grained sand and clay.	Excellent ability to store and yield water.
		Raritan	Kmr	30 - 2000		
Early Paleozoic (?)		Wissahickon	Pzw	(?)	Schist.	Confining bed

AQUIFER
BIBLIOGRAPHY

Markley, Marco L., 1971 Soil Survey: Burlington County New Jersey, U.S. Department of Agriculture in cooperation with N.J. Agricultural Experiment Station, p. 120.

Rush, Eugene F. 1968, Geology and Ground-Water Resources of Burlington County, N.J., U.S. Geological Survey, Special Report no. 26, p. 65.

Rush, Eugene F., 1962 Records of Wells and Ground-Water Quality in Burlington County, N.J., U.S. Geological Survey Water Resources Circular no. 7, p. 104.

Rhodehamal, Edward C., 1971, Hydrological Cycle of the Pine Barrens, Water Resource Circular no. 76, p. 22.

Chapter 5

Vegetation and Wildlife

Natural vegetation of Bass River Township is predominantly of the Pine Barrens varieties, with some tidal marsh vegetation found along streams in the southeastern portions of the Township - the areas of Wading, Mullica and Bass Rivers, and Ballanger Creek. Agricultural areas, current and abandoned, have brought about changes in the natural vegetation, which is discussed. Fire, a most common occurrence, is a great influence on the overall vegetation of the region, and will be included at the conclusion of this section.

The southern portion of Bass River Township is located in the tidal marsh areas. The vegetation in the region is represented by those species which can tolerate the repeated ebb and flow of the brackish tidal water. The predominant native plants found here would be salt-tolerant grasses and sedges. Salt hay (Spartina) was harvested, but is no longer cut in this area. Moving upland and northward, the area changes radically above the ecotone.

One startling exception are areas of slightly higher altitude than the surrounding tidal marsh lands. Oak Island and several other "islands" of higher ground with Downer, Evesboro and Klej soils have the varied flora characteristics of moderately drained soils, and abundant water supply. Similar areas border the tidal marsh lands as well.

Moving inland from the tidal marshlands, a belt of hardwood swamp forest is found, with some cedar swamp located along the edge of the small streams. This area does contain some islands of oak-pine and pine-oak forest east and north of New Gretna. Also on either side of Route 9, east of Job's Creek and west of Off Shore Manor sections of oak-pine/pine-oak forest can be found.

Northward and east of the Bass River the predominant vegetation cover is pine-oak forest, extending to the northern boundary with Woodland Township. The northeast region of Bass River Township bordering Ocean County is an area of pineland commonly called the Lower or East Plains, an area of stunted pine trees and oaks.

The northern area, bounded by the Oswego River, Oswego Lake, and Papoose Branch is an area of lowland with extensive cedar swamps along the waterways, backed by pitch pine lowland forest. There is some cranberry culture along the tributaries of the Oswego.

Following the Oswego southward from Oswego Lake, cedar swamp is found along the river with hardwood swamp beginning in the Buck Run area and continuing to Harrisville Pond. East of Harrisville is an extensive pine and oak forest which meets the hardwood swamp forest/cedar swamp which borders the Beaver Run.

North of the New Gretna area and north westward to Beaver Run is an area of mixed vegetation. The lowland areas along streams are pitch pine lowland forest, hardwood swamp forest and cedar swamp. The higher areas between the lowlands is pine oak forest.

The following descriptions explain in detail the various covers described in this section:*

Cedar Swamp Forests

Southern white cedar swamp forests are dense, even-aged stands of straight-stemmed small-crowned, dark-foliaged coniferous trees. The cedars average 50 to 60 feet tall, but their height varies with age. Stands nearly 100 feet tall have been reported. Cedar swamps fringe many Pine Barren streams from their sources to tidewater and vary from a few yards to a mile or more in width. Pitch pines are widely scattered and red maple, black gum, and sweet bay form a more or less continuous understory in most cedar forests. Dangleberry, highbush blueberry, clammy azalea, fetterbush, bayberry, and various other shrubs grow beneath and mingle with the low crowns of broad-leaved trees. The herbaceous flora of the cedar swamp is highly varied, although the herbs usually do not form dense growths. Chain fern, partridge berry usually are rather common. Curly grass fern, perhaps the best known swamp plant and most sought by naturalists for observations, is rather rare. There also is a rich moss and lichen flora in these habitats.

Hardwood Swamp Forests

Hardwood swamp forests now are the most common stream-course forests in the survey area. They occupy many stream valleys and fringe the upland edges of cedar forests. Where they grow along smaller stream courses and intermittent drainages, these swamp hardwood forests are known locally as "cripples".

The canopy of most swamp hardwood forests is 25 to 30 feet tall, but a few older stands may reach heights 50 to 75 feet tall. Trident red maple generally is the principal tree, but sweet bay, black gum, and, in places, gray birch and sassafras often are abundant. Pitch pines are scattered through these forests and over many acres the pines outnumber the broadleaved trees. Cedars also occur with the broadleaved trees, so there is a whole spectrum of forest types possible from nearly pure cedar to nearly pure pitch pine swamp forests.

The shrub layer of the hardwood swamp forest contains a variety of species, outstanding among which are highbush blueberry, sweet pepperbush, clammy azalea, leatherleaf, fetterbush, black huckleberry, dangleberry, and sheep laurel. Herbaceous plants, lichens, and mosses of the hardwood swamps generally are the same as those found in cedar swamps.

Pitch Pine Lowland Forests

Pitch pine lowland forests occur in a number of depressions, in many sites along the edges of cedar and swamp hardwood forests, and in other low areas. The canopy of these forests is formed almost solely by pitch pines, and generally is only 15 to 20 feet above the ground. Although the tree layer is composed virtually of one species, more than 20 kinds of shrubs and woody vines are known to occur in the undergrowth. Black huckleberry, sheep laurel, and dangleberry are the most prominent shrubs. In fact, the extensive development of sheep laurel is a principal characteristic of the forest type. In places with the poorest drainage, sometimes over very extensive areas, leatherleaf forms the bulk of the undergrowth.

*Adapted from - McCormick, Jack, The Pine Barrens - A Preliminary Ecological Inventory, State of New Jersey - State Museum, Trenton.

The herbaceous layer is exceptionally well developed in pitch pine lowland forests. Turkey beard, an herb with large clumps of grasslike leaves and with large clusters of white flowers (related to the western bear-grass), is the most typical species. Wintergreen and bracken fern also are common and more than a dozen other species including several orchids, are frequent. Spongy mats of sphagnum mosses cover about 10 percent of the ground.

The pitch pine lowland forest is a transitional type between lowland and upland vegetation types. Many species of shrubs, herbs, mosses, and lichens found in pitch pine lowland forests also were common in upland sites. Black huckleberry, one of the most important shrubs in the uplands, covers about the same proportion of the ground in pitch pine lowland sites as it does in upland pine and oak forests.

Nonforest vegetation, including ponds, savannas, and shrub types, occurs in many lowland sites, but generally these areas have been influenced by human action, or organic deposits once present in them have been burned away. Many are former cranberry bogs or reservoirs.

Shallow, intermittent ponds occupy many depressions and occur along streams throughout the area. Ponds formed by dams are more or less permanently filled and are deeper. Water lilies, spatterdock, bladderworts, and various other rooting and floating water plants occur in deeper areas. Grasses, sedges, rushes, and many herbs occur as emergents in shallow waters and along the pond banks.

Sedge and grass marshes, known locally as savannas, are found in a few small openings along streams and on several abandoned cranberry bogs. These wet meadows apparently were much more abundant in the area bout 1900, particularly along the branches of the Wading River south of Chatsworth. These areas now are covered by cedar swamp forests or are utilized for cranberry and blueberry production.

Spongs (rhymes with rungs) are lowland sites covered with dense shrub growths. Chiefly, spongs are occupied by leatherleaf, but highbush blueberry also occurs in them. Fringes of leatherleaf, typically encircled by highbush blueberry, grow around most ponds. Leatherleaf also forms dense stream-bottom stands and in such situation appears to have overgrown a former pond or savanna.

Upland Vegetation

The tree layer of the upland forests of the Pine Barrens is more varied in composition than that of the lowland forests, primarily because of the addition of several species of oak. Shortleaf pine also grows only in upland sites. The lower layers of the forest, however, are much less diverse. Several lowland shrubs are absent from the uplands and others are much less abundant. But it is the striking reduction in the diversity of the herbaceous and moss-lichen flora that is most impressive. Several hundred species grow in lowland areas, but the number probably does not greatly exceed a hundred in upland sites.

The heath undergrowth in upland forests of the Pine Barrens is 1 to 2 feet tall and very uniform; it changes but slightly from one forest type to another. Lowbush blueberry and black huckleberry are the most abundant and widely distributed species of shrubs. Over much of the survey area, scrub oak (or bear oak), a 3- to 15-foot tall shrub, is inserted into the lower cover of the heaths. No real pattern in the occurrence of scrub oak was apparent, although it is much more common in the central and eastern parts of the survey area than in the west part.

Because of differences between pitch pine and the oaks in foliage, seasonal appearance, and, generally, in ecology, the upland forests of the Pine Barrens, usually are considered to be composed of two general types, those formed chiefly by pines and those formed chiefly by oaks. Pine forests give the region its typical aspect and cover about half the total area. However, pine forests cover at least 70 percent of the study region, and perhaps as much as 85 percent of the eastern part of the region.

Pine-Blackjack Oak Forests

The pine-blackjack oak forest is found in higher elevations in the township. It is composed of an open stand of pitch pines, generally about 25 feet tall, and blackjack oaks, generally about 10 to 15 feet tall. Post oaks, about the same height as the blackjack oaks, are abundant in some places. Black oaks are scattered through the pine-blackjack oak forest.

The Plains

One of the most interesting aspects of the Pine Barrens vegetation is known as the "Plains". They are found in a great area encompassing parts of Stafford and Union Townships in Ocean County and Woodland and Bass River Township in Burlington County. Only a southern part of the area known as the East Plains lies in Bass River Township.

The Plains vegetation is distinctive in that it contains two dominant tree species, although there are extensive acreages where their height is extremely small. (3' - 7') These trees seem to be races or species variants whose incidence is incidence is influenced by factors such as forest fire frequency and often droughty soil conditions. In the understory and ground cover, shrubs and herbs similar to those of the upland forest are found. The broom crow, a special denizen of the pine barrens is more extensively found in the plains vegetation.

LISTS OF FLORA IN BASS RIVER TOWNSHIP

In the heart of the Wading River ecosystem, Bass River Township to date is the most undisturbed and most representative area of the Pine Barrens. Its plentiful reserves of pure water, its unique biota and location in the watersheds of the Wading, Bass and Oswego Rivers, make Bass River Township a jewel of nature to be preserved as much as possible in its present pristine state.

The following tables of flora and fauna list much of the vegetation and wildlife which, with very few exceptions, are all found in Bass River Township. To preserve this land is to preserve a natural resources heritage that is in constant danger of being destroyed. Such destruction would end the rural quality of life to be found presently in Bass River Township.

A growing concern for rare and endangered plants has been demonstrated by recent publications. "Rare or Endangered Vascular Plants of New Jersey" by David E. Fairbrothers and Mary Y. Hough, Department of Botany, Rutgers University, Science Notes No. 14 lists scarce plants found only in the Pine Barrens, and some are only found in Bass River Township. The few remaining known speciments of these plants must be protected and preserved in their natural environment. Only by maintaining many "wild" areas under public ownership or areas in recreational uses of minimal environmental impact, can populations of these endangered species be maintained or increased.

Flowering Plants - Herbaceous

* Species originally described from the New Jersey Pine Barrens
** Northern species reaching Southern limit
*** Southern species reaching Northern limit

Arethusa – Arethusa bulbosa
Arrow-arum – Peltandra virginica
Arrowhead, Broad-leaved - Sagittaria latifolia
*** " , Long-beaked - S. australis
" , Slender - S. teres S. Wats. - Rare
* *** Asphodel, Bog - Narthecium americanum
*** " , False - Todfieldia racemosa - Rare
Aster, Bog - Aster nemoralis
" , Bushy - A.dumosus
" , Eastern Silvery - A. pilosus
*** " , Golden - Chrysopsis falcata - Rare
*** " , Late Purple - Aster patens
" , New York - A. Novi-belgii
" , Salt Marsh - A. tenuifolius
" , Silvery, A. concolor L. - Rare
*** " , Slender - A. gracilis
" , Stiff-leaved - A. linariifolius
" , Twiggy - A. vimineus
" , Wavy-leaved - A. undulatus
" , Woodland - A. divaricatus
" , White-Panicled - A. simplex
" , White-top - Sericocarpus asteroides

Bartonia, Upright - Bartonia virginica
*** Bedstraw, Pine Barren - Galium pilosum
Var. puncticulosum
Bee Balm - Monarda fistulosa
Beggerticks, Black - Bidens frondosa
Black-eyed Susan - Rudbeckia hirta
Bladderwort, Fibrous - Utricularia fibrosa
" , Horned - U. cornuta
" , Minute - U. olivacea
" , Pin-like - U. cleistogama
" , Purpole - U. purpurea - Rare
" , Rush - U. juncea
*** " , Swollen - U. inflata
" , Zig-zag - U. subulata
*** Blazing Star, Hairy - Liatris graminifolia
var. lasia
(Known only in N.J. Pine Barrens & Delaware)
Bluecurls - Trichostema dichotomum
Blue-eyed Grass - Sisyrinchium atlanticum
*** Boneset, White - Eupatorium album
" , climbing - E. scandens
" , E. perfoliatum
* " , Sticky - Eupatorium resinosum
Bouncing Bet (Soapwort) - Saponaria officinalis
* *** Bush-clover, Hairy - Lespedeza hirta var. longifolia
" , Round-headed L. capitata
Butter-and-Eggs - Linaria vulgaris
*** Camphorweed - Heterotheca subaxillaris
Campion, White, or Evening Lynchnis - Lychnis alba
Cardinal Flower - Lobelia cardinalis
Chamomile, Corn - Anthemis arvensis
Chicory - Cichorium intybus
Chickweed, Common - Stellaria media
" , Mouse-ear - Cerastium vulgatum
Cinquefoil, - Potentilla sp.
Clover, Rabbit Foot - Trifolium arvense
Colicroot - Alestris farinosa
Cowbane, Slender-leaved - Oxypolis rigidior longifolia
Cow-wheat - Melampyrum lineare
Dandelion, Dwarf - Krigia virginica
" , Common - Taraxacum officinale
" , Red-seeded - T. erythrospermum
Dropseed, Late Flowering - Muhlenbergia uniflora
Evening Primrose, Sinuate-leaved - Cenothera laciniata
Everlasting, Early - Antennaria neglecta
" , Pearly - Anaphalis margaritacea
" , White - Gnaphalium obtusifolium
False Foxglove, Downy - Gerardia virginica
" , Fern-leaved - G. pedicularia

Fleabane, Daisy - Erigeron annuus
" , Philadelphia or Common - E. philadelphicus
*** " , Marsh - Pluchea purpurascens - Undetermined
Flower-or-an-Hour - Hibiscus Trionum
Frostweed - Helianthemum canadense
Gentian, Closed, Soapwort - Gentiana saponaria
*** " , Pine-barrens - G. autumnalis L. - G. porphyrio Gmel. - Endangered
Gerardia, Purple - Gerardia purpurea
" , Pine Barren - G. racemulosa
" , Bristle-leaved - G. setacea
" , Seaside - G. maritima
" , Slender - G. tenuifolia
*** Goat's-rue - Tephrosia virginiana
Golden Aster, Maryland - Chrysopsis mariana
" , Sickle-leaved - C. falcata - Rare
* *** Golden-crest - Lophiola americana
Golden Club - Orontium aquaticum
Golden-pert - Gratiola aurea
** Goldenrod, Bog - Solidago uliginosa
" , Downy - Solidago puberula
" , Elliott's - S. elliottii - Rare
" , Flat-topped, Lance-leaved - S. graminifolia
" , Slender - S. erecta
*** " , Pine-barrens - S. fistulosa
" , Seaside - S. sempervirens
" , Sweet-scented - S. odora
" , Swamp - S. neglecta
" , Tall - S. altissima
*** " , Wand-like - Erect - S. stricta - Endangered
Grass-Pine - Calopogon pulchellus
Hawkweed - Hieracium spp
Heal-all - Prunella vulgaris
Horsemint, Common - Monarda punctata
Indian-pipe - Monotropa uniflora
Iris, Larger Blue - Iris versicolor
" , Slender Blue - I. prismatica
Ironweed, New York - Vernonia noveboracensis
Jewelweed, Touch-me-not - Impatiens capensis
Joe-Pye-Weed - Eupatorium dubium
Jointweed, Coast - Polygonella articulata
Knawel - Scleranthus annuus
* *** Ladies'-tresses, Grass-leaved - Spiranthes praecox - Rare
*** " " , Little - S. tuberosa - Rare
" " , Nodding - S. cernua
" " , Southern Slender - S. gracilis
Lady's-slipper, Stemless - Cypripedium acaule
*** Lettuce, Grass-leaved - Lactuca graminifolia
Lily, Turk's-cap - Lilium superbum
* *** Lobelia, Canby's - Lobelia canbyi - Rare
*** " , Boykin's - L. boykinii - Endangered
" , Nuttall's - L. nuttallii

Loosestrife, Bulb-bearing - Lysimachia terrestris
" , Purple - Lythrum salicaria
Lidwigia, Globe-fruited (False Loosestrife) - Ludwigia sphaerocarpa
*** " , Hair - L. hirtella
Lupine - Lupinus perennis
Marsh Pink - Sabatia angularis
" " - S. stellaris
" " - Large - S. dodecandra
Mallow, Seashore - Kosteletskya virginica
" , Crimson-eyed - Hibiscus moscheutos
" , Swamp Rose - H. palustris
* *** Meadow Beauty, Deergrass - Rhexia aristosa - Endangered
" " , Maryland - R. mariana
" " , Virginia - R. virginica
Milkweed, Blunt-leaved - Ascelpias amplexicaulis
" , Common - A. syriaca
" , Orange, Butterflyweed - A. tuberosa
*** " , Red - A. rubra - Undetermined
*** " , Smooth orange - A. lanceolata - Undetermined
" , Swamp - A. incarnata
Milkwort, Cross-leaved - Polygala cruciata
" , Orange, Candyroot - P. lutea
*** " , Racemed - P. polygama
* *** " , Short-leaved - P. brevifolia
Morning-glory - Convolvulus spp.
* " " , Pickering's - Brewerica pickeringi var. caesariensis(Known to occur only in New Jersey Pine Barrens)
** Muhly, One Flowered - Muhlenbergia uniflora
* *** " , Torrey's - M. torreyana
Mullein, Common - Verbascum thapsus
" , Moth - V. blattaria
Nightshade - Solanum dulcamara
" - Black S. nigrum
Orchis, Crested Yellow - Habenaria cristata - Endangered
" , Green Woodland - H. clavellata
* *** " , Southern Yellow - H. integra - Endangered
" , White Fringed - H. blephariglottis
" , Yellow-fringed , H. ciliaris - Endangered
Ox-eye Daisy - Chrysanthemum leucanthemum
Partridge Pea - Cassia fasciculata
*** Pencil-flower, Hairy - Stylosanthes biflora var. hispida
" " , Sprawling - S. riparia
Pickerelweed - Pontederia cordata
Pineweed, Orange Grass - Hypericum gentianoides
Pineweed, Large - Lechea villosa
" , Oblong-fruited - L. racemulosa
" , Thyme leaved - L. minor
Pipewort, Flat - Eriocaulon compressum
" , Seven-angled - E. septangulare
" , Ten-angled - E. decangulare
Pitcher-plant - Sarracenia purpurea
Pogonia, Rose - Pogonia ophioglossoides
*** " , Spreading - Cleistes divaricata - Endangered

Pokeweed - Phytolacca americana
Primrose, Evening, Common - Centhera biennis
*** " " , Cut-leaved - O. laciniata
Queen Anne's Lace, Wild Carrot - Daucus carota
*** Ragwort, Wooly, Squaw-weed - Senecio tomentosus
*** Rattlesnake Master, Tall - Ernygium yuccifolium
Rattlesnake Plaintain - Goodyera
Rattlesnake-root, Gall-of-the-earth - Prenanthes trifoliolata
*** " " , Pine-barrens - P. autumnalis - Endangered
" " , Pursh's, Lion's-foot - P. serpentaria
Redroot - Lachnanthes tinctoria
*** Sabatia, Lance-leaved, Centuary - Sabatia difformis
Sage, Lyre-leaved - Salvia lyrata
St. John's-wort, Canada - Hypericum canadense
*** " " , Coppery - H. denticulatum
" " , Marsh - H. virginicum
Sandwort, Pine-barren - Arenaria caroliniana
Sclerolepis - Sclerolepis uniflora
Scullcap, Hyssop - Scutellaria integrifolia
Seedbox - Ludwigia alternifolia
Sneezeweed - Helenium autumnale
Spatter-dock, Floating - Nuphar variegatum
Spanish-needles - Bidens bipinnata
Speedwell, Corn - Veronica arvensis
Spurge, Cypress - Euphorbia cuparissias
Spurge, Ipecac - Euphorbia Ipecacvanhae
Star-flower - Trientalis borealis
Sundew, Round-leaved - Drosera rotundifolia
" , Spatulate-leaved - D. intermedia
" , Thread-leaved - D. filiformis
Sundrops, Dwarf - Oenothera perennis
" , Narrow-leaved - O. futicosa
*** Sunflower, Narrow-leaved - Helianthus angustifolius
*** Swamp Pink - Helonias bullata
Tansy, Bitterbuttons - Tanacetumsulgare
Thoroughwort, Common (See Boneset) - Eupatorium perfoliatum
" , Hyssop-leaved - E. Hyssopifolium
" , Rough - E. pilosum
Thistle, Canada - Cirsium arvense
" , Yellow - C horridulum
*** Tickseed-sunflower, Tall - Bidens coronata
Tick-trefoil, Hairy Small-leaved - Desmodium ciliare
" " , Rigid - D. rigidum
* *** " " , Stiff, Beggar's Ticks - D. strictum - Undetermined
Toadflax, Bastard - Comandra umbellata
" , Blue - Linaria canadensis
*** Turkey-beard, Pine Blossom - Ierophyllum asphodeloides
Twayblade, Bog - Liparis Loeselii - Rare
" , Lily-leaved - L. lilifolia - Undetermined

Venus's Looking-glass - Specularia perfoliata
Vervain, Blue - Verbena hastata
Violet, Birdfoot - Viola pedata
*** " , Lance-leaved - V. lanceolata var. vittata
" , Ovate-leaved - V. fimbriatula
*** " , Primrose-leaved - V. primulifolia
Water-lily - Fragrant - Nymphaea odorata
Water-Parsnip - Sium suave
Whitlow-Grass - Draba verna
Wild Bean - Apios americana
" " , Pink - Strophostyles umbellata
" " , Trailing - S. helvola
Wild Indigo - Baptisia tinctoria
Wild Sensitive Plant - Cassia nictitans
Yarrow - Achillea millifolium
Yellow-eyed Grass, Carolina - Xyris caroliniana
** " " , Congdon's - X. congdoni
*** " " , Fringed - X. fimbriata - Undetermined
" " , Slender - X. torta
*** " " , Twisted - X. flexuosa

Flowering Plants - Grasses, Reeds, Rushes, Sedges, Sundry Herbaceous Vegetation, both aquatic and terrestrial

Beach Grass - Ammaophila breviligulata
* Beaked Rush - Rhynchospora kneiskerni (Known only from New Jersey Pine Barrens and Delaware) - Rare
" " , Brown - R. fusca
" " , Capitate - R. cephalantha
*** " " , Clustered - R. glomerata
*** " " , Few-flowered - R. oligantha
* *** " " , Slender - R. gracilenta
" " , White - R. alba
*** Beardgrass - Gymnopogon ambiguus - Rare
*** Bent Grass, Tall - Agrostis altissima
Broomsedge - Andropogon scoparius
*** " " , Virginia - A. virginicus
Bulrush, American - Scirpus americanus
" , Long's - S. longii - Rare
" , Saltmarsh - S. maritimus - Rare
Bur-reed, Slender - Sparganium americanum
Cat-tail, Broad-leaved - Typha latifolia
" , Narrow-leaved - T. angustifolia
Club-rush, Water - Scirpus subterminalis
*** Cotton-grass, Tawny - Eriophorum tenellum
Crab-grass, Large - Digitaria sanguinalis

Cyperus, Gray's - Cyperus Grayii
" , Slender - C. filiculmis
" , Toothed - C. dentatus
" , Umbrella - C. brenifolius - Rare
Eel-grass - Zostera marina
Floating Heart - Limnanthemum lacunosum
Glasswort - Salicornia europea
Hairgrass, Common - Deschampsia flexuosa
Manna-grass, Blunt - Glyceria obtusa
Marsh-grass - Distichlis spicata
*** Millet Grass, Pinelands - Amphicarpum purshii
Nut Rush - Scleria triglomerata
*** " , Shining - S. nitida
* *** " , Slender - S. minor
Panic Grass, Bog - Panicum lucidum
" " , Britton's - P. ensifolium
* *** " " , Hirst's - P. hirstii - Endangered
" " , Narrow - P. hemitomum - Rare
" " , Warty - P. Warty - P. verucosum
*** " " , Sheathed - P. cryptanthum
" " , Starved - P. depauperatum
*** " " , Three-leaf - P. trifolium
" " , Wright's - P. Wrightianum - Rare
Plantain, Narrow-leaf - Plantago lanceolata
" , Broad-leaf - P. major
" , Seaside - P. juncoides
*** Plume Grass - Erianthus alopecuroides
Povery Grass - Aristida dichotoma
Ragweed, Low - Ambrosia artemisii
Reed - Grass, Common - Phragmites communis
" , Nuttall's - Calamogrostis cinnoides
* *** " , Pine-Barren - Calamovilfa brevipilus - Rare
Rice, Wild - Zizania aquatica
Rose, Marsh - Rosa palustris
Rush, Bayonet - Juncus militaris
" , Common, Soft - J. effusus
" , Canadian - J. canadensis
* *** " , New Jersey - J. caesariensis
" , Proliferous, Brown fruited - J. pelocarpus
Salt Marsh Cord Grass, Thatch - Spartina alterniflora
Salt Meadow Grass, Salt Hay - S. patens
Sandbur, Field - Cenchrus longispinus
Sand grass - Triplasis purpurea
Sea Lavender - Limonium spp.
Sea Rocket - Cakile edentula
Sedge, Barratt's - Carex barrattii - Rare
" , Bladder - C. intumescens
" , Button - C. bullata
" , Coast - C. exilis
" , Fox - C. vulpinoidea
" , Gray's - C. grayi
" , Greenish-white - C. albolutescens
** " , Livid - C. livida

Grasses (continued)

Sedge, Long - C. folliculata
** " , Northern Three-fruited - C. trisperma, var. billingsi
" , Pennsylvanis - C. pennsylvanica
" , Pine Barren - C. cylindricus
" , Tussock - C. stricta
" , Walter's - C. walteriana
Spike-Rush, Green - Eleocharis olivacea
" " , Tubercled - E. tuberculosa
Switchgrass - Panicum virgatum
Triple-awned Grass, Beach - Aristida tuberculosa
" " " , Slender - A. longispica
Twig-Rush - Cladium mariscoides
Widgeon-grass - Ruppia maritima
Wild Oat Grass - Danthonia spicata
" " , Silky - D. sericea
*** " " , Smooth - D. epilis
*** Wire Grass - Aristida stricta
* ** Wool-grass, Long's - Scirpus longii
" " , Pedicelled - S. rubricosis

Flowering Plants - Shrubs, Sub-Shrubs and Woody Vines

Alder - Common - Alnus serrulata
Arrowwood toothed - Viburnum dentatum
Azalea, Swamp - Rhododendron viscosum
Bayberry - Myrica pensylvanica
*** " , Evergreen, Wax Myrtle - M. heterophylla
Bearberry - Arctostaphylos uva-ursi
Blackberry, Running Swamp - Rubus hispidus
" , Sand - R. cuneifolius
Blueberry, Black - Vaccinium atrococcum
" , High Bush - V. corymbosum
" , Low Bush - V. vacillans
" , New Jersey - V. caesariense
* ** Broom Crowberry - Corema conradii - Endangered
Buttonbush - Cephalanthus occidentalis
Cactus, Prickly Pear - Opuntia humifusa
Cutbrier (see Greenbrier)
Chokeberry, Black - Aronia melanocarpa
" , Red - A. arbutifolia
Cocklebur - Xanthium echinatum
Cranberry - Vaccinium macrocarpon
Dogbane, Spreading - Apocynum androsaemifolium
Dewberry - Rubus flagellaris
Elderberry - Sambucus canadensis
Fetter-bush - Leucothoe racemosa
Grape, Fox - Vitis labrusca
Grape, Summer - V. aestivalis

Shrubs (continued)

Greenbrier, Common - Smilax rotundifolia
*** " " , Walter's - S. walteriana
Groundsel-Tree - Baccharis halimifolia
Honeysuckle, Japanese - Lonicera japonica
" " , Trumpet - L. sempervirens
Huckleberry, Black, Gaylussacia baccata
" " , Blue, Dangleberry - G. frondosa
*** " " , Dwarf, Grouseberry - G. dumosa
Hudsonia, Poverty Grass - Hudsonia ericoides
Hudsonia - H. tomentosa
Inkberry - Ilex glabra
Ivy, Poison - Rhus radicans
Juneberry - Amelanchier spp.
Laurel, Mountain - Kalmia latifolia
" , Sheep - K. angustifolia
Leather-leaf, Cassandra - Chamaedaphne calyculata
Locust, Clammy - Robinia hispida
Loosestrife, Swamp - Decodon verticillatus
Maleberry, Privet andromeda, - Lyonia ligustrina
Marsh Elder - Iva frutescens
*** Mistletoe - Phoradendron flavescens - Rare
Oak, Dwarf Chestnut - Quercus prinoides
Oak, Scrub - Q. ilicifolia
Partridge-berry - Mitchella repens
Plum, Beach - Prunus maritima
Poison Oak - Rhus toxicodendron
Prince's Pine, Pipsissewa - Chimaphila umbellata
*** Pyxie Moss - Pyxidanthera barbulata
St. Andrew's Cross - Ascyron Hypericoides
St. Peter's-wort - Ascyron stans
St. John's-wort, Shrubby - Hypericum densiflorum
* Sand Myrtle - Leiophyllum buxifolium (Known to occur only in the New Jersey Pine Barrens)
*** Sawbrier - Smilax glauca (see Greenbrier)
Shad-bush, Low - Amelanchier obovalis
" " , Swamp - A. canadensis
Shinleaf - Pyrola secunda
Stagger-bush - Lyonia mariana
Steeple-bush - Spirea tomentosa
Sumac, Dwarf - Rhus copallina
" , Poison - R. vernix
" , Smooth - R. glabra
Sweet-fern - Comptonia perearina
Sweet Pepperbush - Clethra alnifolia
Trailing Arbutus - Epigaea repens
Virginia Creeper - Parthenocissus quinquefolia
*** Virginia-Willow, Tassel-White - Itea virginica
Winterberry - Ilex verticillata
Wintergreen, Teaberry - Gaultheria procumbens
" " , Spotted - Chimaphila maculata
Withe-rod - Bivurnum cassinoides
Yucca, Adam's Needle - Ycca filamentosa

Flowering Plants - Trees

Ailanthus - Ailanthus altissima
Apple - Pyrus malus
Birch, Gray - Betula populifolia
Buttonwood - Plantanus occidentalis
Catalpa, Southern - Catalpa bignonioides
Cherry, Wild - Prunus serotina
Cedar, Eastern Red - Juniperus virginiana
" , Southern White - Chamaecyparis thyoides
" , Northern White, Arbor Vitae - Thuja occidentalis
Dogwood, Cornus florida
Gum, Sour - Nyssa sylvatica
" , Sweet - Liquidambar styraciflua
*** Hickory, Pale - Carya pallida
Holly, American - Ilex bpaca
Locust, Black - Robinia pseudo-acacia
Magnolia, Swamp (Sweet Bay) - Magnolia virginiana
Maple, Red - Acer rubrum
Mulberry, White - Morus alba
Oak, Black - Quercus velutina
", Blackjack - Q. marilandica
" , Chestnut - Q. prinus
" , Post - Q. stellata
" , Red - Q. rubra
" , Scarlet - Q. coccinea
" , Spanish - Q. falcata
" , White - Q. alba
Pear, Choke, Pyrus communis
Persimmon - Diospyros virginiana
Pine, Pitch - Pinus rigida
*** " , Pond - P. serotina
" , Short-leaf - P. echinata
" , White - P. strobus
Poplar, White - Populus alba
Sassafras - Sassafras albidum
Sycamore - Platanus occidentalis
Tamarack, Larch - Larix laricina
Tulip Tree - Liriodendron tulipifera
Walnut, Black - Juglans nigra
Willow, Black - Salix nigra

Non-Flowering Plants - Ferns, Lichens, Mosses

Club-Moss, Carolina - Lycopodium carolinianum
" " , Fox-tail - L. alopecuroides
" " , Ground Cedar - L. complanatum
" " , Ground Pine - L. obscurum
Fern, Adder's-tongue - Ophioglossum vulgatum
" , Bog, Massachusetts - Dryopteris simulata
" , Bracken - Pteridium aquilinum
" , Cinnamon - Osmunda cinnamomea
* ** " , Curly-grass - Schizaea pusilla

Ferns (continued)

Fern, Ebony Spleenwort - Asplenium platyneuron
" , Marsh - Dryopteris thalypteris
" , Royal - Osmunda regalis
" , Virginia Chain - Woodwardia virginica
Horsetail, Common - Equisetum arvense
Moss, Haircap - Polytrichum juniperinum
" , Pigeon Wheat - P. commune
" , Pin Cushion - Leucobryum glaucum
Sphagnum Moss - spp
Moss, Broom - Dicranum (sp.)
Lichen - Thallose - Parmelia spp.
" , British Soldier - Cladonia cristatella
" , Reindeer Moss - C. C. rangiferina
" , Old Man's Beard - Usnea barbata
Liverwort, Thallose - Pallavicinia lyelli
" " , Cepholosia (sp)
" " , Odontoschisma (sp)

A List of Fish Species in the Great Bay - Mullica River Estuary *

Alewife — Alosa poendoharengus
American Eel — Onguilla rostrata
Atlantic Menhaden - Brevortia tyrannus
Atlantic Needlefish — Strongylura marina
Banded Killifish — Fundulus diaphanus
Bay Anchury — Anchora mitchilli
Black crappie — Pomoxis nigromaculatus
Blueback herring — Alosa aestivalis
Bluefish — Pomotomus saltatrix
Bluegill — Lepomis macrochirus
Brown, Bulkhead — Ictalurus nebulosus
Chain pickerel — Esox niger
Crevalle — Caranx hippos
Cunner — Tautogolabrus adspersus
Fusiform darter — Etheostoma frisiforme
Four-spined stickleback — Apeltes gnadracus
Golden shiner — Notemigonus crysoleucas
Hickory Shad — Alosa mediocris
Hogchoker — Trinectes maculatus
Johnny darter — Etheostoma nigrum
N. Kingfish — Menticirrhus saxatilis
Mullet — Mugil sp.
Mummichog — Fundulus heteroclitus
Naded goby — Gobiosoma fosci
Northern pipefish — Gyngnathus fuscus

* Courtesy: Paul E. Hamer, Principal Fisheries Biologist, N.J. Bureau of Fisheries, Nacote Creek Experimental Station

Northern puffer - Gphaeroides maculatus
Oyster toadfish – Opsanus tarr
Permit – Trachinotus falcatus
Pollock – Pollachius virens
Red hake – Urophycis chuss
Sand lance – Ommodytes americanus
Sea bass – Centropristes striatus
Sea herring – Clupea harengus harengus
Sea horse – Hippocampus hudsonius
Sea robin – Prionotus sp.
Sennet – Sphyrena borealis
Sheepshead minnow – Cyprinodon variegatus
Silver perch – Bairdiella chrysura
Silversides – Menidia sp.
Smallmouth flounder – Etropus microtomus
Smooth dogfish – Mustelus canis
Spiny boxfish – Chilomyeterus schoepfis
Spot – Leiostomus xanthurus
Pinfish – Lagodon rhomboides
Spottailed shiner – Notropis hudsonius
Striped anchovy – Anchoa hepsetus
Striped bass – Morone saxatilis
Striped killifish – Fundulus majolis
Striped mullet – Mugil cephalus
Summer flounder – Paralichthys dentatus
Sunfish – Cepomis gibbosus
Tautog – Tautoga onitis
Three-spined stickleback – Gasterosteus aculeatus
Weak fish – Cynoscion regalis
White catfish – Ictahirus catus
White mullet – Mugil curema
White perch – Morone americanus
White sucker – Catostomus commersoni
Windowpane – Scophthalmus aguosus
Winter flounder – Pseudopleuronectes americanus
Yellow perch – Perca flavescens

Fish found in the Pine Barrens
(From McCormick, Jack, The Pine Barrens – A Preliminary Ecological Inventory. State of New Jersey and the Academy of Natural Sciences, Philadelphia, N.J. State Museum, Trenton, N.J.)

Redfin pickerel – Esox americana
Chain pickerel – Esox niger
Eastern mudminnow – Umbra pygmaea
Golden shiner – Notemigonus cyrsolencas
Ironcolor shiner – Notropis chalybaeus
White sucker – Castostomus commersoni
Creek chubsucker – Erimyzon oblongus
Yellow bulehead – Tetalus natalis
Brown bulehead – Tetalus nebulosus
Tadpole,madtom – Noturus gyrinus

American eel – Anguilla rostrata
Banded killifish – Fundulus diaphanus
Pirate perch – Ophredoderus sayanus
Mud sunfish – Acantharchus pomatis
Blackbanded sunfish – Enneacanthus chaetodon
Banded sunfish – Enneacanthus obesus
Bluespotted sunfish – Enneacanthus gloriosus
Red-breasted sunfish – Lepomis gibbosus
Yellow perch – Perca flavescens
Johnny darter – Etheostoma olmstedi
Swamp darter – Etheostoma fusiforme
Small mouth bass – Micropterus dolimicui

Several small sunfishes are common here, but rare elsewhere. Pickerel are common enough to attract fishermen to cranberry reservoirs and larger streams but the region's fish are of greater interest to the naturalist than to the sportsman.

Amphibians and Reptiles

The area supports a varied herpeto-fauna in which several species that are rare or seldom found elsewhere are abundant. Outstanding among these are the Pine Barrens Treefrog, the Carpenter frog and the harmless Pine snake. The Timber rattlesnake is the only poisonous snake to be found in our township. Although it is an inhabitant of rocky areas in other regions, in the rockless Pine Barrens the rattler is a lowland animal and hibernates in the damp sands of stream banks. Water snakes found in the township will bite when harassed but are not poisonous. They are often mistaken for poisonous snakes like the cottonmouth or water moccasin that have never been found in our area.

Frogs and Toads

Bull frog – Rana castesbeiana
Carpenter frog – Rana virgatipes
N.J. Chorus frog – Pseudacris triseriata kalmi
Northern Cricket frog – Acris c. crepitans
Green frog – Rana virgatipes
Southern Leopard frog – Rana pipiens sphenocephala
Pickerel frog – Rana palustris
Eastern Gray Tree frog – Hyla v. versicolor
Pine Barrens Tree frog – Hyla andersoni
Wood frog – Rana sylvatica
Northern spring peeper – Hyla c. crucifer
Fowler's Toad – Bufo woodhousei fowleri
Spadefoot toad – Scaphiopus holbrooki

Salamanders and Lizards

Northern Dusky salamander – Desmognathus f. fuscus
Eastern Four-toed salamander – Hemidactylium scutatum
Jefferson's salamander – Ambystoma Jeffersonianum

Marbled salamander - Ambystoma opacum
Eastern red-backed salamander - Plethodon c. cinereus
Northern red salamander – Pseudotriton r. ruber
Eastern mud salamander – Pseudotriton montanus montanus
Slimy salamander – Plethodon glitinosus glutinosus
Spotted salamander – Ambystoma maculatum
Northern two lined salamander – Eurycea bislineata B.
Eastern tiger salamander - Ambystoma t. tigrinum – Rare, Endangered
Four toed salamander – Hemidactylium scutatum
Ground skink - Lygosoma laterale
Common five lined skink – Eumeces fasciatus
Red spotted newt – Diemictylus v. viridescens
Northern Fence lizard – Sceloporus undulatus hyacinthus

Snakes

Timber rattlesnake – Crotalus h. horridus - Rare
Northern Brown Snake (DeKay's) – Storeria d. dekayi
Smooth brown snake – Coronella austruaca
Corn snake – Elaphe g. guttata - Not abundant
Eastern Earth snake – Haldea v. valeriae – Rare
Common garter snake – Thamnophis s. sirtalis
Rought green snake – Opheodrys aestivus
Eastern hognose snake – Heterodon platyrhinus
Eastern King snake – Lampropeltis g. getulus
Coastal Plain Milk snake – Lampropeltis doliata triangulum
Northern Pine snake – Pituophis m. melanoleucus
Black Rat snake – Elaphe o. obselata
Northern Red Bellied snake – Storeria o. occipitomaculata
Eastern Ribbon snake – Thamnophis s. sauritus
Eastern Ring Neck snake – Diadophis p. punctatus
Scarlet snake – Cemophora coccinea
Common Water snake – Natrix s. sipedon
Leather snake – N. septim vittata
Eastern Worm snake – Carphophis a. amonenus
Northern Black Racer – Coluber c. constrictor

Turtles

Stinkpot or common musk turtle - Sternothaerus odoratus
Northern diamond backed terrapin - Malaclemys t. terrapin
Bog turtle – Clemmys Muhlenbergi - Endangered
Eastern box turtle - Terrapene c. carolina
Common mud turtle - Kinosternon s. subrubrum
Eastern painted turtle – Chrysemys p. picta
Red-bellied turtle - Pseudemys rubiventris
Common snapping turtle – Chelydra s. serpentina
Spotted turtle – Clemmys guttata
Wood turtle – Clemmys insculpta - Rare

Birds

Waterbirds

Black Duck – Anas rubripes
Mallard Duck – Anas platyrhynchos
Wood Duck – Aix sponsa
Hooded Merganser – Lophodytes cucullatus
Green-Winged Teal – Anas carolinensis
Blue-Winged Teal – Anas discors
Red-Breasted Merganser – Mergus serrator
Pintail – Anas acuta
Gadwall – Anas strepera
Baldpate – Mareca americana
Redhead – Aythya americana
Canvasback – Aythya valisineria
Ring necked – Aythya collaris
Lesser scaup – Aythya affinis
Common Goldeneye – Bucephala clangula
Bufflehead – Bucephala albeola
Ruddy – Oxyura jamaicensis

Pied Billed Grebe – Podilymbus podicapo
Horned Grebe – Podiceps auritus
Common Loon – Gavia immer
Double Crested Cormorant – Phalacrocorax auritus
Mute Swan – Cygnus olor
Whistling Swan – Olor columfianus

Waders

Great Egret – Casmerodius albus
Snowy Egret – Leucophoyx thula
Cattle Egret – Bubuleus ibis
Great Blue Heron – Ardea herodias
Louisiana Heron – Hydranassa tricolor
Little Blue Heron – Florida caerulea
Green Heron – Butorides viresceus
Black crowned night heron– Nycticorax nycticorax
Yellow Crowned night heron– Nyctanassa violacea
American Bittern – Botaurus lentigineous
Least Bittern – Lxobrychus exitis
Glossy Ibis – Plegadis falcinellus
Virginia Rail – Rallus limicola
Sora Rail – Porzona carolina
Black Rail –Laterallus jamaicensis – Rare
Clapper Rail – Rallus longirostris
King Rail – Rallus elegans – Endangered
American Coot – Fulica americana

Birds (continued)

American Oystercatcher – Haemotopus palliatus
American Avocet – Recurvirostra americana
Black Necked Stilt – Himantopus mexicanus

American Golden Plover – Phivivialis dominica
Black Bellied Plover – Squatarola aquatarola
Piping Plover – Charadrius vociferus
Whimbril – Numenius americanus
Marbled godwit – Limosa fedoa
Hudsonian godwit – Limosa haemastica
Solitary Sandpiper – Tringa soliteria
Spotted Sandpiper – Actitis macularia
Willet – Catoptrophorus semipalmatus
Giter Yellowlegs – Totanus flavipes
Long Billed dowitcher – Limnodronius scalopaceus
Short Billed Dowitcher – Limnodronius griseus
Ruddy Turnstone – Arenaria interpres
Knot – Calidris canutus
Dunlin – Erolia alpina
Sanderling – Crocethia alba
Least sandpiper – Erolia minutilla
Semipalmated Sandpiper – Ereunetis pusillus
American Woodcock – Philohela minor
Common Snipe – Capella gallinago
Gt. Black Backed Gull – Larus marinus
Herring Gull – Larus argentatus
Ring Billed Gull – Larus delawarensis
Laughing Gull – Larus atricilla
Bonaparte's Gull – Larus philadelphia
Forster's Tern – Sterna forsteri
Least Tern – Sterna albifrons
Common Tern – Sterna hirundo
Black skimmer – Rynchops nigra

Canada Goose – Branta canadensis
Brant – Branta bernicla
Snow Goose – Chen hyperborea

Turkey Vulture – Cathartes aura
Black Vulture – Coragyps atratus
Peregrine Falcon – Falco peregrinus - Endangered
Goshawk – Accipiter gentilis
Sharp Showned Hawk – Accipiter striatus
Cooper's Hawk – Accipiter Cooperii - Endangered
Marsh Hawk – Circus cyaneus – Declining
Roughlegged Hawk – Buteo lagopus
Redtailed Hawk – Buteo jamaicensis
Red Shouldered Hawk – Buteo lineatus
Broad Winged Hawk – Buteo platypterus

Birds (continued)

American Kestrel – Falco sparverius
Golden Eagle – Aguila chrysaetos – Endangered
Bald Eagle– Haliautus leucocephalus – Endangered
Osprey – Pandion haliaetus – Endangered
Pigeon Hawk – Falco columbarius – Declining
Ruffled Grouse – Banasa umbellus
Bobwhite – Colinus virginianus
Ring-necked pheasant – Phasiannus colchicus
Turkey – Meleagris galloparo – Endangered

Barn owl – Tyto alba
Screech owl – Otus asio
Great Horned owl – Buto virginianus
Short eared owl – Asio flammeus
Saw whet owl – Aegolius acadicus
Mourning Dove – Zenaidura macrowia
Yellow Bill Cuckoo – Coccyzus americana
Black Bill Cuckoo – Coccyzus erythrapthalmus
Whip-Poor-Will – Caprimulgus vociferus
Common Nighthawk – Chardellis minor
Chimney Swift – Chaetura pelagica
Ruby Throated Hummingbird – Archilochus colubris
Belted Kingfisher – Megaceryle alcyon
Common Flicker – Colaptes auratus
Red-Bellied Woodpecker – Centurus carolinus
Red headed Woodpecker – Melanerpes erythrocelzhalus – Endangered
Yellow bellied Sapsucker – Sphyrapicus varius
Hairy Woodpecker – Dendrocopos villosus
Downy Woodpecker – Dendrocopos pubescens
Eastern Kingbird – Tyrannus tyrannus
Great Crested Flycatcher – Myiarchus crinitus
Eastern Phoebe – Sayornis phoebe
Yellow Bellied Flycatcher – Empidonax flaviventris
Older Flycatcher – Empidonax alnorun
Least Flycatcher – Empidonax minimus
Acadian Flycatcher – Empidonax virescens
Eastern Wood Pewee – Coutopus virens
Horned Lark – Eremophila alpestris
Barn Swallow – Hirundo rustica
Tree Swallow – Iridoprocne bicolor
Cliff Swallow – Petrochelidon pyrrhonota
Rough winged Swallow – Stelgidoptery ruficollis
Purple Martin – Progne subis
Blue Jay – Cyanocitta cristata
Common Crow – Corvus corax
Fish Crow – Corvus ossifragus
Black-capped Chickadee – Parus atricapillus
Carolina Chickadee – Parus carolinensis
Tufted Titmouse – Parus bicolor
White-breasted Nuthatch – Gitta carolinensis

Birds (continued)

Red breasted Nutchatch – Gitta canadensis
Brown Creeper – Certhia familiaris
House Wren – Troglodytes aedon
Carolina Wren – Thryothorus ludovicianus
Winter Wren – Troglodytes troglodytes
Long Billed Wren – Telmatodytes palustris
Short Billed Wren – Cistothorus platensis – Rare
Mockingbird – Minus polyglottos
Cat bird – Dumetella carolinensis
Brown Thrasher – Toxostoma ruf
Robin – Turdus migratorius
Wood Thrush – Hypocichla mustelina
Hermit Thrush – Hypocichla guttala
Swainson's Thrush – Hypocichla ustulata
Gray checked Thrush – Hypocichla minima
Veery – Hypocichla fuscescens
Eastern Bluebird – Sialia sialis – Rare
Blue gray Gnatcatcher – Polioptila caerulea
Golden Crowned Kinglet – Regulus satrapa
Ruby Crowned Kinglet – Regulus calendula
Cedar Waxwing – Bombycilla cedrorum
Loggerhead shrike – Lanius ludovicianus
Starling – Sturnus vulgaris
Solitary vireo – Vireo solitarius
White Eyed Vireo – Vireo griseus
Red Eyed Vireo – Vireo olivaceus
Philadelphia Vireo – Vireo philadelphicus
Yellow-Throated Vireo – Vireo flavifrons

Black and White Warbler – Mniotilta varia
Prothonotary Warbler – Protonotaria citrea – Rare
Golden Winged Warbler – Vermivora chrysoptera
Blue-Winged Warbler – Vermivora pinus
Tennessee Warbler – Vermivora peregrina
Nashville Warbler – Vermivora suficappilla
Parula Warbler – Parula americana
Yellow Warbler – Dendroica petechia
Magnolia Warbler – Dendroica magnolia
Cape May Warbler – Dendroica tigrina
Yellow rumped Warbler (myrtle) – Dendroica coronata
Black Throated Green Warbler – Dendroica virens
Black Throated Blue Warbler – Dendroica caerulescens
Black burnian Warbler – Dendroica fusca
Chestnut sided Warbler – Dendroica pensylvanica
Bay Breasted Warbler – Dendroica castanea
Blackpoll Warbler – Dendroica striata
Pine Warbler – Dendroica pinnus
Prairie Warbler – Dendroica discolor
Palm Warbler (Western and yellow) – Dendroica palmarum

Birds (continued)

Ovenbird Warbler — Seiurus aurocapillus
Northern Waterthrush — Seiurus noveboracensis
Louisiana Warbler — Seiurus motacolla
Common Yellowthroat Geothlypis trichas
Yellow Breasted Chat — Icteria virens
Kentucky Warbler — Oporonis formosus
Mourning Warbler — Oporonis philadelphia
Connecticut Warbler — Oporonis agilis
Hooded Warbler — Wilsonia citrina
Wilson's Warbler — Wilsonia pusilla
Canada Warbler — Wilsonia canadensis
American Redstart — Setophaga ruticilla

House Sparrow — Passer domesticus
Eastern Meadowlark — Sturnella magua
Red-winged Blackbird — Agelaius phoeniceus
Common Grackle — Quiscalus quiscula
Brown-Headed Cowbird —M olothrus ater
Northern Oriole (Baltimore) — Icterus galbula
Scarlet Tanager — Piranga olivacea
Cardinal — Richmondena cardinalis
Rose-Breasted grosbeak — Pheuticus ludovicianus
Evening Grosbeak — Hesperiphona vespertina
Indigo Bunting - Passerina cyanea
Purple Finch — Carpodacus mexicanus
Common Redpole — Acanthis flammea
Pine Siskin — Spinus pinus
American Goldfinch — Spinus tristis
Red Crossbill — Loxia curvirostra
White-winged crossbill — Loxia leucoptera
Rufous-sided Towhee — Pipilo erythrophthalmus
Savannah sparrow - Passerculus sandwichensis
Henslow's Sparrow— Passerherbulus henslowii - Rare
Sharp-Tailed Sparrow — Ammospiza caudacuta
Seaside Sparrow — Ammospiza maritima
Vesper Sparrow — Povecetes gramineus
Dark eyed Junco — Junco hyemalis
Tree Sparrow — Spizella arborea
Chipping Sparrow — Spizella passerina
Field Sparrow — Spizella fusilla
White-crowned Sparrow — Zonotrichia atricapilla
White-throated Sparrow — Zonotrichia albicollis
Fox Sparrow — Passerella iliaca
Lincoln's Sparrow — Melospiza lincolnii
Swamp sparrow — Melospiza georgiana
Song sparrow — Melospiza melodia

Mammals

Big Brown Bat – Eptesicus fuscus
Least Brown Bat – Balanpioteryx plicata
Little Brown Bat – Myotis lucifugus
Hoary Bat – Lasiurus cinereus
Keen's Bat – Myotis keenii septentrionalis – Rare
Red Bat – Lasiurus borealis
Silver Haired Bat – Lasionycteris noctivagans
Beaver – Castor canadensis
Eastern Chipmunk – Tamias striatus
Eastern Cottontail – Silvilagus floridanus
New England Cottontail – Sylvilagus transitionalis – Restricted range - Rare
White Tailed Deer – Odocoileus virginianus
Gray Fox – Urocyon cinereoargentus
Red Fox – Vulpes fulva
European Hare – Lepus europaeus
Southern Bog lemming – Synaptomys cooperi - Rare
Mink – Mustela vison
Eastern Mole – Scalopus aquaticus
Hairy Tailed Mole – Parascalops breweri
Star Nosed Mole – Condylura cristata
Deer Mouse – Peromyscus maniculatus gracilis
House Mouse - Mus musculus
Meadow Jumping Mouse – Zapus hudsonius
WoodlandJumping mouse – Napeozapus insignis insignis – Northern
Redbacked Mouse – Clethrionomys gapperi
Whitefooted Mouse – Peromyscus leucopus
Muskrat – Ondatra zibethica
Opposum – Didelphis marsupialis
River Otter – Lutra canadensis – Endangered - Extremely Rare
Eastern Pipistrelle – Pipistrellus subflavus
Porcupine - Erethezon dorsatum
Black Tailed Jack Rabbit – Lepus californicus
Raccoon – Procyon lotor
Black Rat – Rattus rattus
Norway Rat – Rattus norvegicus
Rice Rat – Oryzonys palustries – Coastal Marshes
Common shrew – Sorex cinereus
Least Shrew – Cryptotis parva – Brackish meadows along Wading River
Masked shrew – Sorex cinereus
Little Short Tailed Shrew – Blarina brevicauda
Smokey shrew – Sorex fumeus fumeus – Sparce
Striped skunk – Mephitis mephitis
Southern Flying Squirrel – Glaucomys volans
Gray Squirrel - Sciurus carolinensis
Red Squirrel – Tamiasciurus hudsonicus
Meadow Vole – Microtus pennsylvanicus
Pine Vole – Pitymys pinetorum
Longtail Weasel – Mustela frenata
Woodchuck - Marmota monax

Ecological Study Plots for Vegetation

Three acre sized plots have been identified and studied to develop basic data for annual growth and plant flowering regimes. The study plots were selected because they represent three contrasting plant community types.

The annual reporting study is expected to provide complete data on plants which appear and mature in different seasons as well as data on growth rate, species longevity and species competition. One study plot is in the shore of a lake where some clearing and mowing has occurred. This land use practice favors the growth of many species which are favored by greater light intensity and less abundant organic soil surface litter.

Hopefully, such data can guide the Planning Board in achieving its goal of providing more optimum environments for wild species on public or private lands.

The study of the three sites was initiated during the research phase for this resource inventory and periodic site visits for data collection will be made by Mrs. Mary Schmidt and, hopefully, other residents or friends of the Township.

Site Descriptions

Site No. 1 – Timberline Lake-North Shore

Location Description – Alongside unpaved roadway along north shore of Timberline Lake byond the second dike across the lake. The specific area extends between the roadway and the shoreline from a long pitch pine, 25' in height, westward 250 feet to a point opposite a "No Trespassing" sign affixed to a tree on the North side of the road.

The land had been cleared, but now has about 80% plant cover.

The first lists, as this report is printed, were compiled before tree leaves were available for identification of some species. The plots were selected and identification made on April 11, 1974. No plants were in bloom except pyxie moss.

Species Listing

Common Name	Scientific Name	Estimated Number of Individuals or % cover in the area	Dates observed in flower
Canopy Species			
Pitch Pine	Pinus rigida	1	
Understory Species			
Pitch Pine	Pinus rigida Mill. (seedlings)	30 (1'-8')	
Red Maple	Acer rubrum L. (seedlings)	10 clones	
Atlantic White Cedar	Chamaecyparis (L.) thyoides BSP.	2	
Sassafras	Sassafras albidum (Nutt.)Nees	5	
Chokeberry	Aronia sp?	2	
Shadbush	Amelanchier sp?	15	
Scrub Oak	Quercus ilicifolia Wang	25	
Black-Jack Oak	Quercus marilandica Muenchh	5	
Bitter Gallberry	Ilex glabra (L.) Gray	80	
Bayberry	Myrica pennsylvanica Loisel	18	
Sheep Laurel	Kalmia angustifolia L.	5%	
Sand - Myrtle	Leiophyllum buxifolium (Berg.) Ell	30	
Leatherleaf	Chamaedaphne calyculata (L.) Moench	8%	
Dewberry	Rubus sp?	35	
Laurel leaved Greenbriar	Smilax laurifolia L.	3	
High Bush Blueberry	Vaccinium corymbosum L.	80	
Wooly Heather	Hudsonia tomentosa Nutt.	500	
Cranberry	Vaccinium macrocarpon Ait.	100	
Herbaceous Species			
Brake Fern	Pteridium aquilinum (L.) Kuhn	2%	
Checkerberry	Gaeltherea procumben (L)	1000	
Pyxie	Pyxidanthera barbulata Michx.	70 clones	
Poverty grass	Andropogon sp?	15%	
Golden Milkwort	Polygalalutea (L.)	30	
Turkey Beard	Xerophyllum asphodeloides (L.) Nutt.	10	
Sheep Sorrel	Rumex acetellosa (L.)	22	
Sedge	Carex sp?	4	
Goldenrod	Solidago	3	
Common Bulrush	Juncus effusus (L.) sp?	5	
Canada Rush	Juncus canadensis J. Gay	2	
Pine Barrens Club Moss	Lycopodium carolinianum (L.)	7	
Bog Moss	Sphagnum sp?	5%	
Hair Cap Moss	Polytrichum sp?	11	
British Soldier Lichen	Cladonia cristatella	5%	
Reindeer Lichen	Cladonia rangiferina		

Site no. 2 – West side, Allen Road just north of Bartlett's Branch (of the Bass River) Bridge.

The plot begins 625 feet (by roadway) north of Bartlett's Bridge. From this point on the western side of Allen Road, the plot boundary extends at an azimuth of 268°, approximately 210 feet, to a tree with a white paper tied on the trunk, thence at an azimuth of 25° and a similar distance to a third tree similarly marked, thence at an azimuth of 90° to the Allen Road. The border of Allen Road forms the fourth boundary returning to the place of beginning. The boundary trees at the edge of the road will be marked with white paint on the side away from the road to avoid attraction of other persons into the area.

The area is readily designated as a pitch pine lowlands community, with a few individuals of White Oak (Quercus alba L.) and one Black Oak (Q. velutina Lam.), as canopy trees within the boundary. The understory, in two layers, is dominated by Scrub Oak, (Q. ilicifolia Wang.) and Black Jack Oak (Q. marilandica Muenchh.) for the upper level and, at the lower level, Sheep Laurel, (Kalmia angustifolia, L.) Dwarf Huckleberry (Andr.), T. & G., and Low Huckleberry, (Vaccinium vacillans Torr.), the Teaberry, (Gaultheria procumbens L.) dominates the low species.

The pines provided a canopy of approximately 50% and 470 trees provided this canopy. The number of understory oaks has not yet been determined. Visits were made to the area on April 11, and May 9, 1974. Biweekly visits are projected until November, 1975.

Species Listing

Common Name	Scientific Name	Estimated number of individuals or % cover in the area	Dates observed in in flower
Canopy Species			
Pitch Pine	Pinus rigida Mill.	470	
Black Oak	Quercus velutina Lam.	1	
White Oak	Quercus alba L.	5	
Understory Species			
Pitch Pine	Pinus rigida Mill.	20	5/9/74
Scrub Oak	Quercus ilifolia Wang.	35%	5/9/74
Black Jack Oak	Quercus marilandica Muenchh	15%	5/9/74
Mountain Laurel	Kalmia latifolia L.	21	
Sheep Laurel	K. angustifolia L.	20%	
Dwarf Huckleberry	Gaylussacia dumosa (Andr.) T.&G.	20%	
Low Blueberry	Vaccinium vacillans Torr.	20%	
Sweet Fern	Comptonia peregrina (L.) Coult.	3	
Teaberry	Gaultheria procumbens L.	25%	
Wooly Heather	Hudsonia tomentosa Nutt.	3	
Pyxie	Pyxidanthera barbulata Michx.	9 clones	5/9/74
Trailing Arbutus	Epigaea repens L.	3	
Brake Fern	Pteridium aquilinum (L.) Kuhn	15	

Species Listing (continued)

Common Name	Scientific Name	Estimated Number of individuals or % cover in the area	Dates observed in flower
Laurel leaved Green Briar	Smilax laurifolia L.	5	
Cow Wheat	Melanpyrum lineare Desr.	11	
Common Lady's Slipper	Cypripedium acaule Ait.	4	
Stiff-leaved Aster	Aster linariifolius L.	3	
Broom moss	Dicranum sp?		
Fire moss	Funaria sp?		
Hair Cap moss	Polytrichum sp?		
Reindeer moss	Cladonia rangiferina (Nearing)	80	
Goblet Lichen	Cladonia pyxidata (Nearing)	15	
British Soldier Lichen	Cladonia cristatella (Nearing)	10	
Powder Horn Lichen	Cladonia coniocrea (Nearing)	3	

Site 3 – Cedar Swamp at Bartlett's Bridge.

The study site extends 100 feet directly at right angles to the Allen Road and extending 400 feet southward from Bartlett's Branch. The plot is bounded on its north side by the stream and the water table decreases toward the southern boundary of the plot.

Light intensities beneath the Atlantic White Cedar canopy are low. On April 11, 1974, a sunny day the light intensities ranged from 200 foot candles to 3000 foot candles at 3:00 pm. Approximately 1400 cedar trees were counted in the plot with red maple forming most of the other canopy in a few openings. This plot is interesting to contrast the success of many pine barrens herbs requiring a high water table in brightly lighted and shaded locations. In this shaded plot, for example, both pitcher plants and sundews appear to be repressed in growth.

Species Listing

Common Name	Scientific Name	Estimated Number of individuals or % cover in the area	Dates observed in flower
Canopy Species			
Atlantic White Cedar	Chamaecyparis thyoides (L.) BSP	1600	
Red Maple	Acerrubrum L.	120	
Understory Species			
High Bush Blueberry	Vaccinium corymbosum L.	90	
Swamp Magnolia	Magnolia virginiana L.	30	
Sweet Pepper Bush	Clethra alnifolia L.	4	
Swamp White Azalea	Rhododendrum viscosum (L.) Torr.	7	
Herbaceous Species			
Golden Club	Orontium aquaticum L.	30	5/9/74
American Star Flower	Trientalis borealis Raf.	150	
Round leaved Sundew	Drosera rotundifolia L.	40	
Pitcher Plant	Sarracenia purpurea L.	20	
Yellow Water Lily	Nuphar advena (Ait.) Ait. f.	25	
Liverwort, thallose	Pallavicinia lyelli	200	
Liverwort, leafty	Odonto schisma sp?	8%	
Broom Moss	Dicranum spp?	40	

Forest Fires in the Township

The Pine Barrens or pinelands have been demonstrated to be the dominant vegetational type of the township. Forest fires in the pineland areas apparently favor the continuance of the forest cover as pinelands. Thus fires seem, in the strictest sense, necessary for the continuance of the Pine Barrens. The following data for forest fire extend and incidence is from a report by the Division B Fire-warden for the N.J. Department of Environmental Protection.

Year	Number of Fires	Acres
1963	10	22.50
1964	21	96.25
1965	12	135.50
1966	13	157.00
1967	7	54.50
1968	9	808.00
1969	8	93.25
1970	17	8.75
1971	8	3670.25
1973	9	148.50

The most hazardous fuel type located in Bass River Township is in the area lying north of the Oswego Road or generally called the East Plains Area. This has been classified by the New Jersey Forest Fire Service and the U.S. Fire Service as one of the most rapid and hottest burning fuel types in the United States and is carried on our records as an extreme hazard area. The area south of the Oswego Road, although containing much of the same fuel types as the Plains Area, has been reduced to a medium or high hazard area due to the hazard reduction programs carried out on the Bass River State Forest and surrounding areas.

The continuous, although intermittent, presence of fires in the pinelands mitigates against the safety of people in these wooded areas. To make the area safe for people, significant "fire proof" buffer zones around human habitations need to be maintained. In this sense, pinelands and people are mutually exclusive.

Bass River Township's Pinelands areas need preservation in their present condition because of the following factors:

1. Recreational land use now being maintained in much of Bass River Township is dependent upon woodland (pinelands) vegetation.

   The greatest single land use, in terms of area in the Township is for recreation. Some of the Pinelands unique vegetation and fauna are relatively protected in Bass River State Forest and portions of the Wharton State Forest which lie within the boundaries of the township. A second recreational land use is the maintenance and operation of campsites for trailers and self-propelled camper vehicles.

Both of these recreational land uses are essentially dependent upon a woodland environment. Since most of the native vegetation is the pine or pine-oak tree cover, it is the pinelands vegetation which is vital to the township's recreational interests.

2. Much of the northern and central areas of the Township are already in public ownership.

3. Forest fires are necessary for the preservation of pinelands tree cover in the Township.

   Pinelands as tree cover are well adapted to survive despite the frequency of forest fires in pineland forests. Pine seeds germinate much more successfully on earth or soil surfaces which are devoid or nearly devoid of a cover of organic litter such as dead leaves, pine needles and other plant materials. On the other hand, oaks, maples, and others with heavier seeds reproduce much more successfully in soil protected by organic litter. After a forest fire consumes the organic litter which covers the soil, the germination of pine seeds is greatly enhanced.

   Many pine cones do not open under normal climatic conditions, but the heat of forest fires opens the closed cones, thus providing a fresh supply of seeds immediately following the forest fire.

   The presence of numerous dormant buds in the trunks and older branches of the pitch pine, in particular, allows these native pines to "resurrect" themselves during the same season when the forest fire occurs.

   All of these factors document the fact that Bass River Township's essential pinelands cannot mutually exist with any concentration of human population without the destruction of the pines. Many former communities or other human use areas in the pinelands, some of them long abandoned, are distinguished by a greater dominance of oak or other tree species.

CHAPTER 6 – Existing Land Use and Housing

A graphic representation of the existing land use pattern in Bass River Township is provided by Figure 4. This map dramatically reinforces the impression one gets from travelling along the Chatsworth Road north from New Gretna which, aside from the Parkway, is the most important north-south road in the Township. All of the Township, other than the area immediately surrounding New Gretna, is almost completely undeveloped--providing the natural, pinelands setting documented in other sections of the report. Measurements made by planimetering the various land use categories delineated in Figure 4 disclose that only a tiny portion of Bass River Township's vast acreage (less than 2.2%) has been utilized by those activities of man requiring permanent structures, including highways, roadways, alone account for more than one-half of this undeveloped acreage in the Township. Even when other open land uses are added, including agricultural activities, the percentage of land area presently in use rises only to 3.7%. When these figures are compared with generalized land use percentages for the State as a whole, we find that Bass River Township ranks near the top among those New Jersey municipalities still remaining open and in their natural state.

Noteworthy Considerations

The land use map also clearly shows that population density figures applied to the whole Township would inaccurately depict the nature of the current development since practically all of Bass River's citizens reside in the southern third of the Township, mostly centered in the village of New Gretna. It should be noted that all of this portion of the Township within which development has and is taking place, albeit at a very slow pace, is located within the jurisdictional area of the Coastal Facilities Review Act. This suggests the possibility of the incidence of environmental problems and the need for careful consideration of environmental pollution possibilities in order to avoid degradation of nearby wetlands and estuaries.

Probably the most striking feature of the land use map is that showing the preponderance of wooded area within the Township. The forest types found in Bass River Township are discussed in Chapter 5, but it should be noted here that the Township is an integral part of New Jersey's pine barrens region, with several of its neighboring municipalities having the same type of forest cover and that they, together, comprise a large and unspoiled natural region. While there is relatively little timber management, there is some pulpwood production and, more recently, the harvesting of firewood, some of which is supervised on State owned lands.

With respect to agriculture, there is a negligible amount of conventional farming activity consisting of the keeping of livestock or poultry and field cropping; with the principal agricultural activity consisting of cranberry production at several locations. The relatively small acreage of the Township utilized for agriculture (.9%) has been reduced even further recently through the utilization of cranberry bog areas for campground facilities.

Land in Public Ownership

Probably the second most striking feature of the Land Use Map is that showing public land ownership. It is estimated that some 16,000 acres or approximately 30% of the total area of the Township has been acquired by various public agencies. An important State recreation-camping facility has been developed around Lake Absegami in the Bass River State Forest. The map also shows that many of the public acquisitions have occurred in a sort of checkerboard fashion, with the apparent objective of later filling out the State forest areas by acquisition of intervening parcels.

Updating By Local Survey

Two tables showing land use tabulations for Bass River Township are included here. The first was provided by Burlington County Planning Board in its Preliminary Master Plan for Burlington County, 1972 - 1973. The second summarizes results from an actual land use survey conducted for this inventory in November of 1973. Both tables appear on the pages which follow immediately. The method of tabulation used by the County tends to obscure several important characteristics of Bass River Township's land use pattern.

As an example, the County's tabulation shows a total of only 346 acres of woodland, or a miniscule 0.7% of the Township's area while the environmental inventory team survey discloses over 42,000 acres or 84% of the Township to be forested. Further, the County figures show over 1,500 acres, or more than 3% of the Township, to be devoted to residential use, while our survey disclosed some 200 acres, or less than 0.4% to be so utilized. Our survey figures seem more realistic in view of the fact that the Township's population consists of less than 1,000 people and less than 300 dwelling units. Finally, the County's land use tabulation indicates some 2,800 acres, or 5.7% of the Township land area under the classification "Government", while our survey indicates that presently, public lands involve more than 16,000 acres, or approximately 30% of the Township's area.

1970 Existing Land Use Tabulation*

Bass River Township

79 Square Miles
50,976.00 Total Acres

USE	Total Acres	Percent
Roads 1	1,089.09	2.20
Roads 2	—	—
Single Family Homes	1,564.33	3.16
Multiple Family Homes	—	—
Transient Quarters	—	—
Light Industry	—	—
Heavy Industry	—	—
Transportation & Utilities	—	—
Trade	168.31	0.34
Professional Personal Services	—	—
Government	2,821.73	5.70
Education, Religion, Welfare, Health	94.06	0.19
Recreation	14,717.54	29.73
Farm	975.23	1.97
Woodland	346.53	0.70
Mines, Quarries	—	—
Vacant	27,727.19*	56.01
LAND TOTALS	49,504.01	100.00

*Source: Land use tabulation by Municipality, A Preliminary Master Plan for Burlington County, Burlington County Planning Board, Mt. Holly, N.J. - 1972-73.

Existing Land Use - 1973

Bass River Township*

Land Use	Acreage	% of Total Twp. Area
Roads	699.0	1.37
Residential	200.2	.39
Residential - trailers	28.5	.06
Industrial - inc. excavations	130.4	.26
Commercial	33.1	.06
Public - building sites	11.0	.02
Public open space - undeveloped and mostly forested	16,053.0	31.49
Public open space - developed (campground)	113.0	.22
Quasi-public open space - developed (campground)	219.4	.43
Quasi-public - other developed areas	11.0	.02
Agriculture - inc. cranberry bogs	440.8	.86
Wetland	6,479.5	12.71
Woodland - not incl. in public open space	26,557.1	52.11
	50,976.0	100.00

The vacant land total is negligible and is included within the Woodland Acreage.

*Source: Land Use Field Survey and Planning Board Discussions conducted for Bass River Township, fall of 1973.

Housing and Building Evaluation

The dwellings in Bass River Township, numbering some 350, may with rare exception be classified as modest, especially those which are used as temporary summer residences, fishing shacks, gunning clubs and the like. The current average evaluation of approximately $18,000 reflects only the extraordinary inflation of speculative land prices in the township and not the value of houses which five years ago averaged less than $6,000. In general, the upkeep of homes is excellent. Most occupied houses are in a fine state of repair with good paint and tight roofs, many of them being in the process of renovation by their owners.

Since New Gretna is one of the oldest towns in this area, having had a larger population in the 1870s than it does today, at least 50% of the older houses date from the middle 1800s or earlier, while more "recent" structures built in the traditional methods will average 40-50 years in age. Some of these older houses now stand vacant. Recent individual building activity has not been great but is increasing to an average of three homes per year.

However, two "developments" have brought some 100 houses into the area. The houses are built of modern materials and on modern lines, generally one-story, three-bedroom cottages, without basement, of dry-wall construction, electrically heated and erected on minimum-sized lots (100 x 100 ft.). The average evaluation of these structures is $5000-$6000 above that of the general town average. Many of these houses, however, stand vacant and several have not been sold by their developers.

Since the township provides no public services whatsoever, unless one excepts the maintenance of a solid waste dump area, known as a sanitary landfill, to which residents must carry their own refuse, all houses are built with individual septic systems (indeed some of the older homes still have cesspool disposal) and must have their own wells, even though the geological nature of much of the township precludes intensive construction of this type of disposal and water systems.

Although much of State Highway 9, as it passes through the somewhat undefined limits of the village of New Gretna, is zoned "commercial", most retail establishments are clustered in the vicinity of the corner of U.S. Route 9 and Maple Avenue. With the exception of the gasoline service stations and the New Gretna House, most of the businesses are located in remodeled dwellings and often contain living quarters for the proprietors.

The following tables provide pertinent statistics related to housing and zoning.

See Figure 4, a map depicting existing land use.

Municipal Housing Fact Sheet*

Bass River Township

Total area 79 square miles
Overall density per square mile 10.5
Net Residential density per acre 0.5

	1960	1970	% Change
Persons per housing unit	2	2	0
Total housing units %	269	297	10.41
Owner occupied %	241	253	4
Renter Occupied %	28	44	57

Median owner value $10,075.76

Median contract rent $58.09

Units lacking plumbing facilities 33
**Units with 1.01-1.49 persons per room 8
Units with 1.50 or more persons per room 2

** More than one person per room is considered overcrowding.

* Source – A Preliminary Master Plan for Burlington County, Burlington County Planning Board, Mt. Holly, N.J. 1972 - 1973

EXISTING ZONING TABULATION*

Bass River Township
79 Square Miles
49,504.00 Total Acres

Zoning	Total Acres	Government Land	Net Acres	% of Total Net Acres
Residential Zones:				
R_2 5,000 - 9,999 sq. ft.	5,346.43	256.00	5,090.43	15.27
R_5 40,000 sq. ft. to 3 acres	6,831.55	2,284.80	4,546.75	13.64
R_6 3 acres or over	35,840.90	13,612.80	22,228.10	66.67
Other Zones:				
General Business	1,485.12	12.80	1,472.32	4.42
GRAND TOTALS	49,504.00	16,166.40	33,337.60	100.00

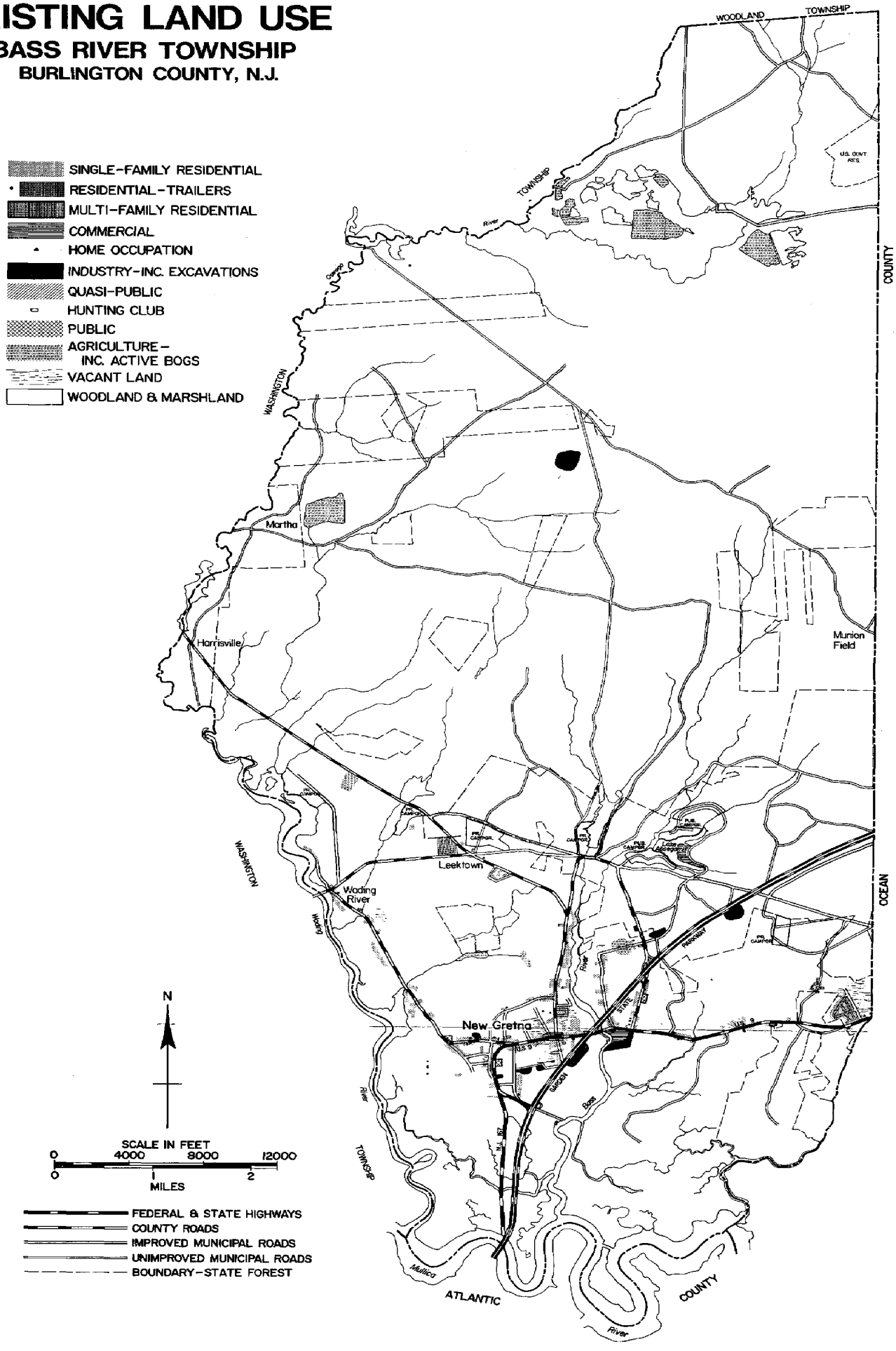
*Source: Preliminary Master Plan, Burlington County Planning Board, Mt. Holly, New Jersey 1972 - 73

FIGURE 4

EXISTING LAND USE

BASS RIVER TOWNSHIP

BURLINGTON COUNTY, N.J.



CHAPTER 7 – Population Characteristics

The population of Bass River Township has increased from slightly over 700 in 1960 to well over 900 in 1973. Bass River Township's population has shown an absolute increase but this increase has massed into a defined area with resultant increase in density. This increase in population and density is a direct result of a small urban type development located in old Mathis Town near the Ocean County line on New York road. The adverse socio-economic impact on the Township as a result of this increase in population can be seen in the increase in unemployment and swelling welfare rolls as additional persons compete for fewer jobs every year. Urbanization of this rural area tends to harden racial and economic lines.

The area of significant population concentration is in the village of New Gretna. Although some growth has taken place, the village has remained rural in character.

The major portion of the Township's population is in the low to middle income bracket, with over 20% of the entire population retired as senior citizens. Less than 10 percent of the population are in the middle to upper middle income levels. The upper middle income bracket is made up of less than 2 percent of the population. Median family incomes have remained generally low because of the relative unavailability of jobs in the immediate area.

The age composition of the Township's population has undergone some change. The senior citizen age group has increased conspicuously. The school age bracket has also shown a markedly increase while the 20 to 45 age range has shown only a slight increase; so slight as to be almost negative. The same is true of the 45 - 64 age group.

Occupations: Professional and technical workers make up less than 2 percent of the working population, while workers in the clerical and sales and labor workers make up the bulk of the labor force in the Township.

Population Analysis Statistics

The following pages present tables analyzing the present population of the Township. The low growth rate is reflected in the large number of residents over 65 years of age. This age group is only rivalled in size by the 10 - 14 year age group. These statistics indicate the dearth of new residence building in the community.

Because the majority of the population is concentrated in the village of New Gretna and one relatively new residential development, the population density approaches 500 persons per square mile in these two areas, which are less than 2% of the entire land area (79 square miles) of the Township. Most of these "undeveloped" lands are either in (1) public ownership, (2) low intensity recreational activity or (3) in tidal wetlands.

The low intensity recreational activity increases the weekend population in favorable weather or in the vacation season by 1200 - 1500 persons.

Population Analysis by Age and Sex*

Bass River Township

Total area 79 Square Miles
Overall density per square mile 10.5

	Male		Female	
	1960	1970	1960	1970
0 - 4	25	21	24	31
5 - 14	53	82	60	59
15 - 24	36	54	27	47
25 - 34	36	26	37	35
35 - 44	37	49	39	43
45 - 54	48	39	45	48
55 - 64	41	59	60	57
65 and over	84	78	85	87
TOTAL	360	408	377	407

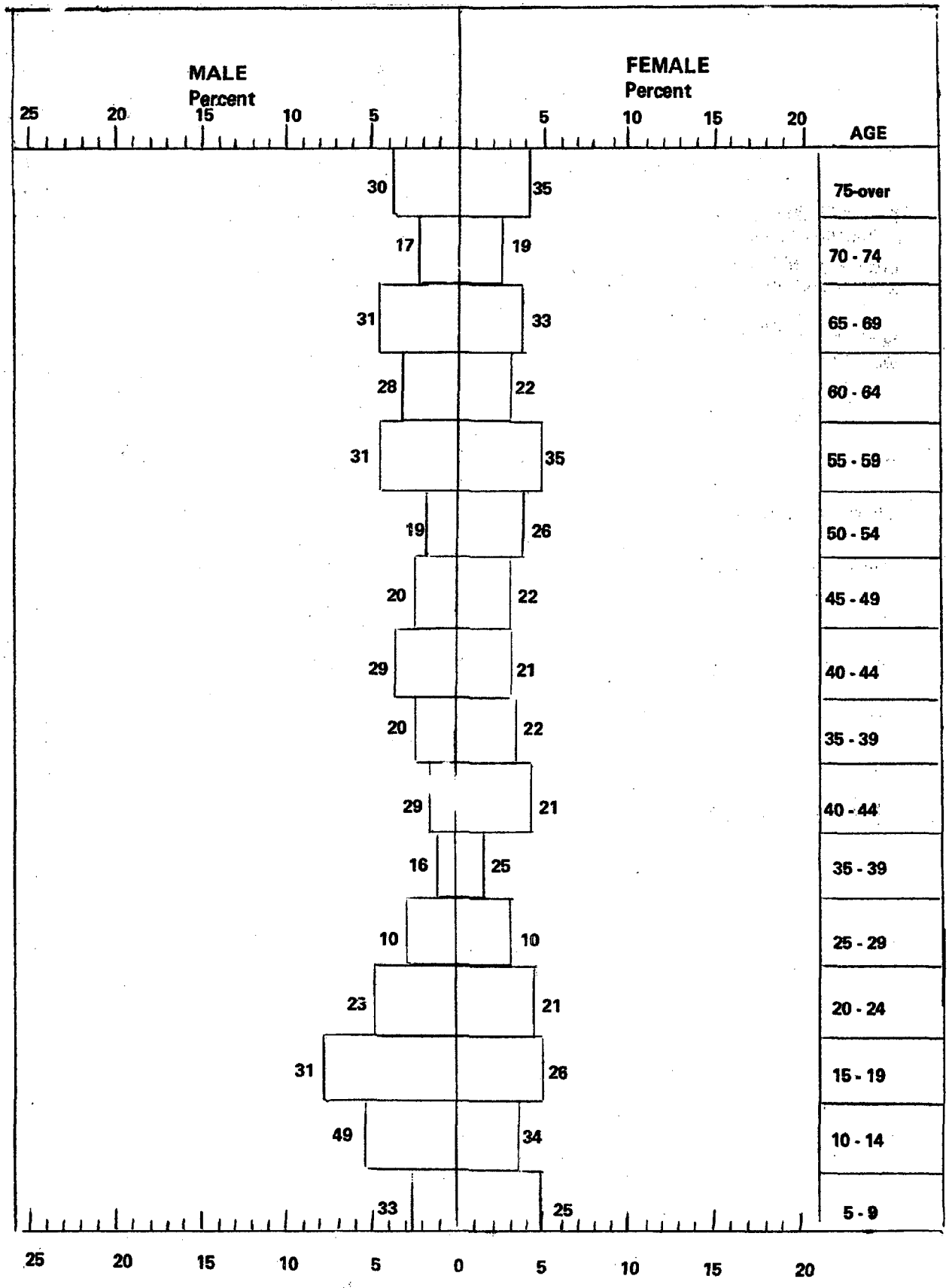
Population Changes

	Population	Difference	% of Change
1940	599	+89	+14.8
1950	688	+49	+ 7.1
1960	737	+78	+10.6

*Source - A Preliminary Master Plan for Burlington County, Burlington County Planning Board, Mt. Holly, New Jersey, 1972 - 73

POPULATION PROFILE *

Bass River Township



*Source - A Preliminary Master Plan for Burlington County, Burlington County Planning Board, Mt. Holly, New Jersey, 1972 - 73

A Comparison of Populations of Neighboring Communities

The communities which are the neighbors of Bass River Township all have similar terrain and land use. Only Galloway Township in Atlantic County and Little Egg Harbor Township in Ocean County have coastal waters and tidal wetlands within their borders.

See Figure 6, Chapter 10 which shows these communities and the portions of their areas held in public ownership.

Populations of Neighboring Communities - 1970 Census

Bass River Township	815
Shamong Township	1,318
Tabernacle Township	2,103
Washington Township	673
Woodland Township	2,032
Galloway Township	8,276
Little Egg Harbor Township	2,972
Stafford Township	3,684
Tuckerton Borough	1,926

Place Names

Names of communities and noted places in a region are often a clue to the kind of people who formerly lived there, their sentiments, their humor, their occupations and perhaps their racial origins. Animals, trees, and land and water forms also contributed frequently to local nomenclature. Some of the intriguing, occasionally puzzling, place names of the New Jersey Pine Barrens show more earthy originality than many of the present day "prestige" names. (Lester S. Thomas, The Pine Barrens of New Jersey).

Some of the more interesting names still in current use in Bass River Township are:

Streams and Water Bodies	Communities	Topographic Areas	Roads & Bridges
Bass River	Sim Place	Calico Ridge	Dan's Bridge
Beaver Branch	Shomong	Moss Point	Bartlett's Bridge
Buck Run	Absegami	Doctor Point	Stage Road
Mill Branch	Martha	Swimming Over Point	Millie Road
Arnold Branch	Tub Mill	Flood Point	
Papoose Branch	Leektown		
Wading River			
Merrygold Branch			
Ives Branch			
Job's Creek			
Lower Pasture Creek			
Polly's Ditch			
World's End Creek			
Broad Creek			
Fish Creek			
Blood Ditch			
Wolf Run			

CHAPTER 8 — Services and Facilities Available to Residents of Bass River Township

U. S. Route 9 has a few business establishments, but they are not able to supply many of the basic needs of the residents. The table which follows indicates the distances which separate residents of the Township from various essential services.

Hospitals	Atlantic City	24 miles
	Southern Ocean County	18 miles
Emergency Service	Tuckerton First Aid Squad	8-10 miles
Doctors	Tuckerton	6 miles
	West Creek	10-12 miles
Schools	Absecon	14 miles
	New Gretna Elementary	19 miles
	Southern Reg. High School	19 miles
Fire Service	New Gretna Volunteers	
Shopping	Pleasantville	14 miles
	Tuckerton	8-10 miles
	Manahawkin	16-18 miles
Gasoline	Exxon, Arco & Sunoco New Gretna	
Heating Oil	Tuckerton	8-10 miles
	Pomona	13 miles
	Egg Harbor	14 miles
Churches	Methodist, Presbyterian - New Gretna	
Cinema	Pleasantville	14 miles
	Atlantic City	24 miles
	Manahawkin	16 miles
	Beach Haven	25 miles
Airport	Atlantic City	25 miles
	International - Philadelphia	60 miles
Buses	To New York or Atlantic City - Route 9 - New Gretna To Philadelphia from Atlantic City, Egg Harbor or Manahawkin	

CHAPTER 9 – TRANSPORTATION

The major roadways linking Bass River Township with major population centers are the New Jersey Garden State Parkway and Route 9. The vast majority of traffic passing through the township is on these roads. The data available indicates that traffic on the Parkway is at least double that of Rt. 9 through New Gretna on a yearly average (see Traffic Chart). Secondary roads such as county Rts. 563, 542, 653 and 654 seem adequate for present conditions. Throughout the mainly uninhabited areas of Bass River Township are numerous dirt roads in various conditions from excellent to poor. These roads are adequate for the few vehicles which currently use them.

The present highway system in Bass River Township appears to be limited in scope but adequate for the present transportation needs of the township. The increased vehicle traffic during the summer months does not overly burden the present available roadways.

The numerous unpaved roads provide ample accessibility to the relatively uninhabited areas of the township and there appears to be little need to pave these roads.

The data on the chart below was made available through the Burlington County Planning Office and the New Jersey Department of Transportation. The majority of the data available refers to Route 9 and the Garden State Parkway. These two roadways are the most heavily utilized in the area. The figures listed represent Average Annual Daily Trips (A.A.D.T.).

Traffic Data Available for Bass River Township

Location	1960	1968	1969	1970	1972
W. Wading River Bridge 542	500				
Rt. 563 - Between 653 and 654			715		
Rt. 542 - Between Wading River & N. Gretna	500	644			
Rt. 9 E. of N. Gretna Near Ocean County Line	3,000	3,640			4,300
Rt. 9 - Between Rt. 563 & Rt. 542	3,400	4,140			
Rt. 9 - West of G.S. Pkway Underpass		4,270			
Rt. 563 - Between 564 & Rt. 9			1,470		800
Rt. 563 - 1 mile west of Rt. 653				621	500
G.S. Pkway - N. of N. Gretna & Ocean County Line	4,300	6,350			8,000
G.S. Pkway - Between Rt. 9 & Atlantic County Line	7,800	9,000			12,000

Bass River Township and U.S. Route 9

Bass River Township and New Gretna are best known to visitors who travel into and through the area via U.S. Highway 9. Before 1953 and the opening of the Garden State Parkway, it was the only significant north/south transportation artery for those moving from New York and Northern New Jersey southward to Atlantic City and Cape May.

For these reasons, Route 9 has a long history as a picturesque two-lane highway with inns, unique crafts shops, neighborhood stores and period architecture. This aesthetically appealing aspect has been fast disappearing on most sections of the highway further north, although significant preservation and period restoration has occurred along Route 9 in nearby Smithville in Atlantic County.

The success of the Smithville Towne Complex and plans for its expansion attest to its considerable economic success. It illustrates the value and utility for preserving the "country - seashore" flavor of Route 9 as an economic and aesthetic asset. Future plans for Bass River Township and New Gretna might well include the preservation and enhancement of the "Route 9 Environment". Standards for design of future buildings along the highway might be needed to achieve this objective.

CHAPTER 10 – Limitations for Development in the Township

There are several factors which limit or tend to impose limitations on development in Bass River Township. In addition to new and stringent limitations recently developed through state legislation to upgrade or maintain the quality of coastal and wilderness environments, there are three additional considerations.

One is the existence of state-owned lands in this Township and neighboring communities. Another is the considerations of environment related industries or industries which can influence relatively large environmental areas. A third additional and significant factor is the attitude of present Township residents with respect to the future development of the Township.

State Regulations

State laws influencing environmental quality govern further development in the Township. Important among these are the Coastal Area Facilities Review Act, the Wetlands Act and the Flood Plain Act, all enacted since 1970.

The Coastal Area Facility Review Act is intended to subject all building and development to an evaluation to determine the impact of that development on the quality of environments to be affected. For Bass River Township, slightly more than one-half of the total land area in the Township, that lying south of Oswego Road, which runs in an east-west direction from Munion Field to Old Martha Furnace is subject to the "Coastal Facility" regulations. (See Figure 5)

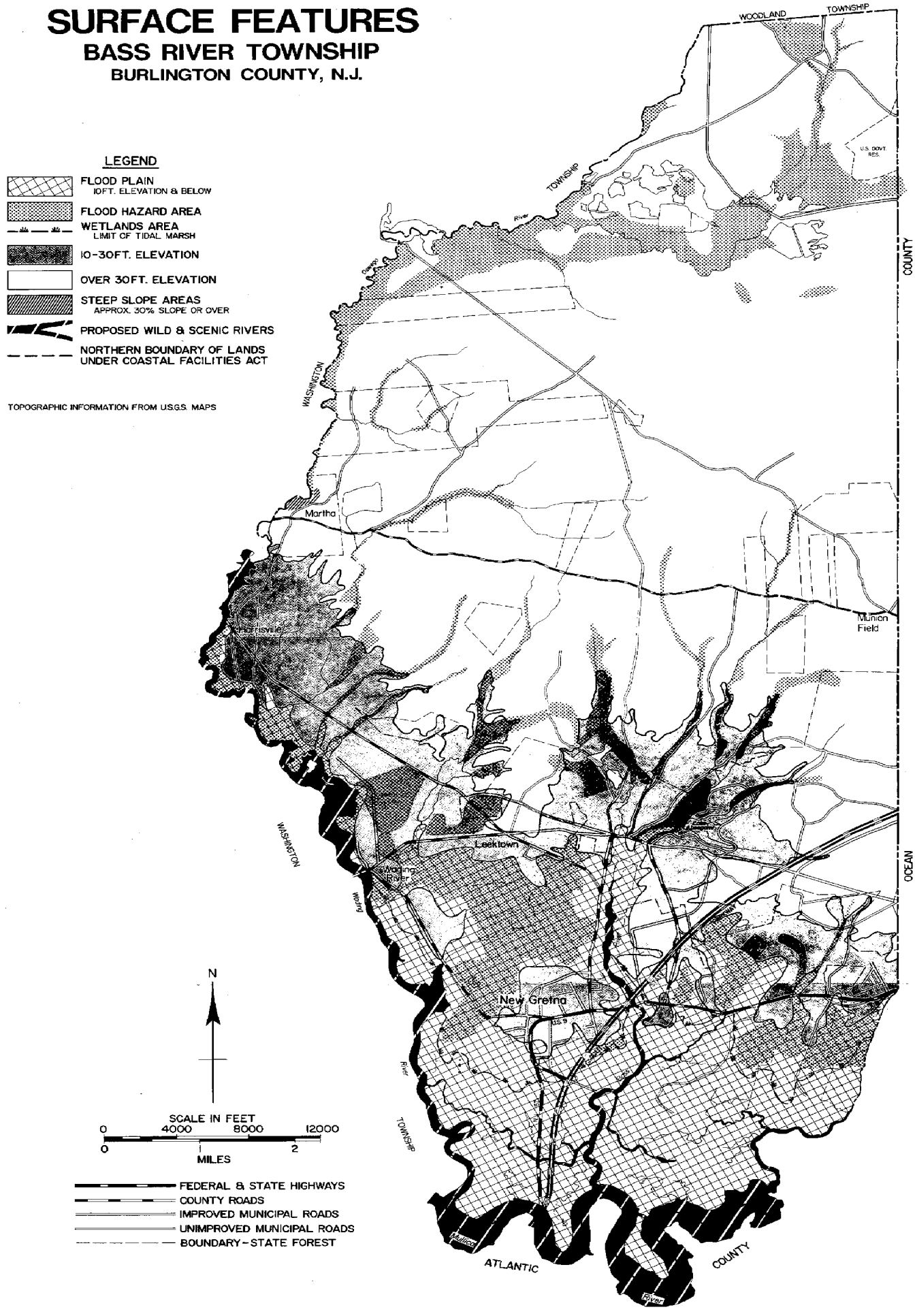
In essence, the Commissioner of Environmental Protection of the State of New Jersey must review an environmental impact statement favorably before issuing a permit for any major construction within the area listed in the act. The list includes most chemical, metallurgical, fertilizer, and food production industries and all residential developments of more than 25 dwelling units. Each environmental impact statement must be approved in an advertised public meeting prior to the obtaining of a permit from the Commissioner.

Three additional State tasks are required in the Coastal Area Facilities Review Act--an environmental inventory, alternate long-term environmental management strategies, and a final environmental design, all of which must be submitted to the Governor and the Legislature within four (4) years from the date the Act became effective. These steps are intended to introduce an element of planning into the coastal area facility review procedure and to provide an environmental framework within which officials enforcing the Act could operate.

The New Jersey Wetlands Act of 1970 provides for stringent State regulation of all tidal wetlands in New Jersey. Under the Act, regulated activities are defined to include draining, dredging, excavation or removal of soil, mud, sand, gravel, aggregate of any kind or depositing or dumping therein any rubbish or similar material or discharging therein liquid waste, either directly or otherwise, and the erection of structures, driving of piling, or placing of obstructions, whether or not changing the tidal ebb and flow. The conduct of any regulated activity in the tidal wetlands as shown on detailed area photographs filed in the County Clerk's office, is subject to a complicated application procedure and the issuance of a permit by the Commissioner of the Department of Environmental Protection. In granting or denying any permit, the Commissioner or

FIGURE 5

SURFACE FEATURES
BASS RIVER TOWNSHIP
BURLINGTON COUNTY, N.J.



his appointed representative must consider the effects the proposed work will have on the public health and welfare, marine fisheries, shell fisheries, wildlife and protection of life or property from flood, hurricane and other natural disasters as well as the general policy for preservation of the wetlands as set forth in the Act.

The New Jersey Flood Plains Act requires that flood plain zoning relating to all New Jersey streams and rivers be accomplished within a specified time period. The Act provides for stringent regulation of structures and land disturbance according to different standards in areas defined as flood plains and flood hazard areas. It permits municipalities to enact flood plain regulations if they act promptly. Otherwise, the State reserves the right to enact regulations directly. A difficulty yet to be overcome is the need for accurate mapping of flood-prone areas. As an interim measure, some municipalities are utilizing data contained in Soil Conservation Service mapping programs to locate areas subject to flooding. This is accomplished by identifying alluvial soil types along stream boundaries

Flood Hazard Areas. Flood hazard areas, as shown in Figure 5, have been defined to include those stream side locations subject to periodic water cover. They conform generally to marsh land designations shown on U.S.G.S. topographic maps, as interpreted by members of the Environmental Commission.

These same flood hazard areas will be further refined according to criteria now being developed by the New Jersey Department of Environmental Protection to implement the New Jersey Flood Plains Act of 1972. The U.S. Soil Conservation Service will also provide interpretations of soil types in flood hazard areas to provide additional criteria to be used as a basis for zoning ordinance provisions regulating land use in flood prone areas of the Township.

Stream Encroachment Law.— This act, dating back to 1929, is the oldest of the State regulatory activities dealing with land use regulation in the vicinity of waterbodies or streams. Under the provisions of the Stream Encroachment Law, no property owner or developer may disturb the existing land form, construct barriers or structures; or change the configuration of any stream without submitting detailed plans and having them approved by the Stream Encroachment Section of the Division of Water Resources.

Wild and Scenic Rivers. — In 1968, the federal government enacted the "Wild and Scenic Rivers Act". This Act declared it to be the policy of the United States that certain selected rivers of the nation which, with their immediate environment, possess outstanding, remarkable, scenic, recreational, geological, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition and that they, and their immediate environments, shall be protected for the benefit and enjoyment of present and future generations. Under this Act, it was determined that, in addition to the established national policy of dam and other construction at appropriate sections of the rivers of the United States, a complementing policy should be established that would preserve other selected rivers or sections thereof in their free-flowing condition, in order to protect the water quality of such rivers and to fulfill other vital, national conservation purposes.

In order to be included in the "Wild and Scenic Rivers" system, a free-flowing stream and its related, adjacent land area must possess one or more of the values referred to above and be authorized for inclusion by United States Congress. Action to include a stream or river in the system may be taken by a State Legislature or by a Governor. Once included in the system, the river or stream is protected from all unnecessary public or quasi-public construction projects and its adjacent land areas are afforded a high priority for public acquisition at all governmental levels.

In Bass River Township, the Mullica River and some of its tributaries and the Bass Rivers have been proposed for inclusion in the "Wild and Scenic Rivers" system. This was done in 1973 by action of both houses of the New Jersey State Legislature. Bass River Township residents were prominent in helping to instigate this legislation. At this writing, the State of New Jersey Department of Environmental Protection must complete the mapping of the stream areas in order to make proper application to the U.S. Department of the Interior.

Topography

The general topography of the Township is depicted by Figure 5 showing those areas subject to normal tidal flooding. In addition, upland areas less than 10 feet of elevation, areas between 10 feet and 30 feet of elevation, and those sections of the Township greater than 30' in elevation, are indicated. Elevations range from sea level in the southern portion of the Township occupied by tidal estuaries, to nearly 200 feet in one section near the Lower Plains area in the North central section.

Two limited areas of steep slope (greater than 30%) are associated north stream banks along the Oswego River, but some are not always immediately adjacent to the present location of the water course. Most stream side locations are relatively flat, often slow to drain and swampy in character. The higher, well-drained areas are located mostly in the north central section, along either side of Allen Road.

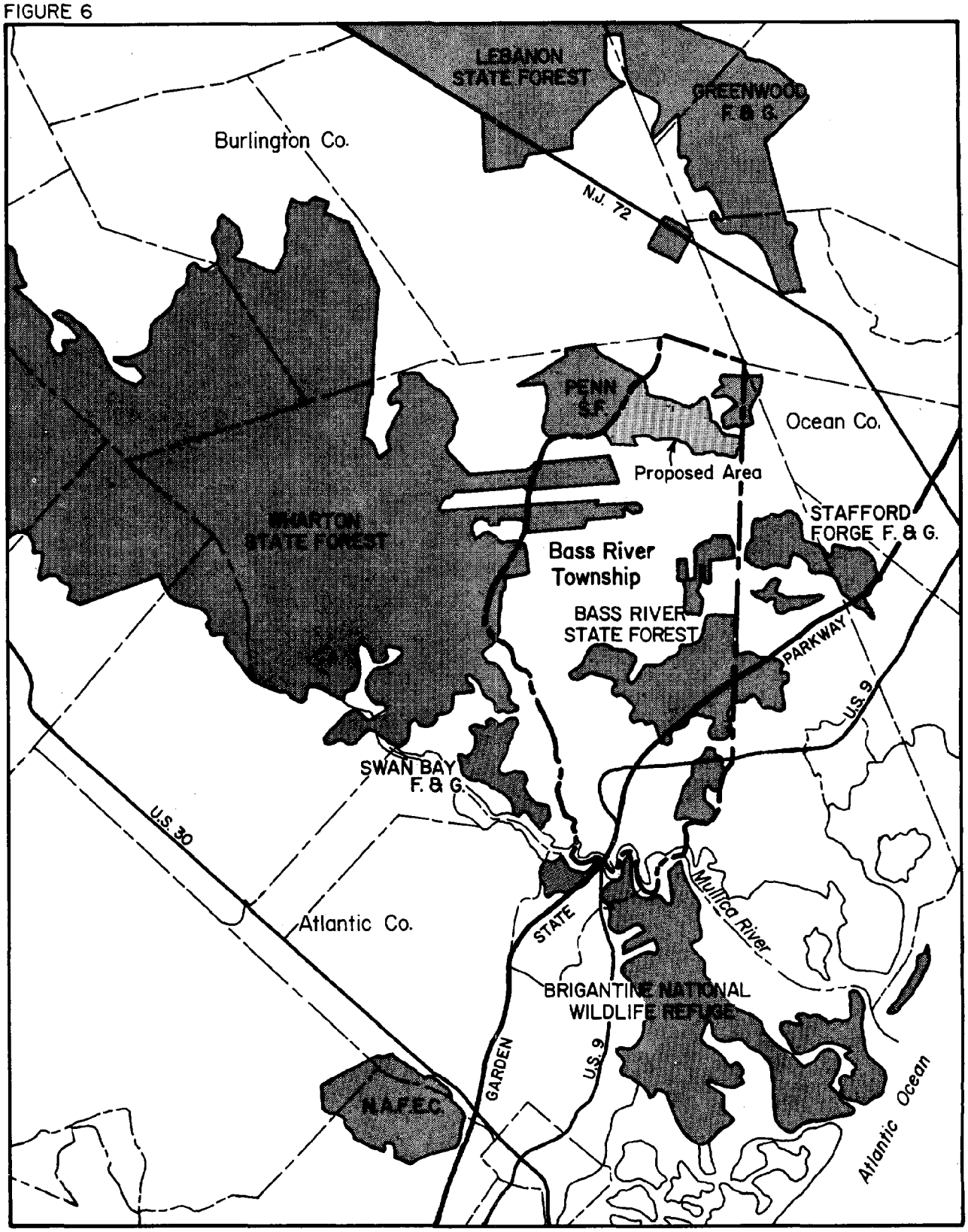
Lands in Public Ownership

The land use statistics have indicated that 30% of the land area in Bass River Township are presently state-owned. At this writing, there is a strong probability that the 3,000 acre Sim Place tract which lies wholly in the northeastern sector of Bass River Township will be acquired by the State of New Jersey for public ownership.

A second tract of approximately 5,000 acres, occupying the north western and central western sectors of the Township has also been proposed to "solidify" and make continuous the present public land areas now designated as parts of the Wharton State Forest and the Bass River State Forest. If these tracts were to pass into public ownership, then nearly 50% of the land area of the Township would be publicly owned.

The Planning Board and others assisting in the development of the Master Plan will need to project land use for the remaining land areas which is consistent with the low intensity recreational use pattern now developing. Figure 6 indicates the present state-owned lands in Bass River Township and its neighboring communities.

FIGURE 6



REGIONAL MAJOR PUBLIC LAND HOLDINGS

Source: Major Public Open Space & Recreation Areas in N.J. (Map) by N.J.D.E.P.

Environmental Requirements and Impact of Present Industries in the Township

There is a complex of industries in the Township related to recreation activities, agriculture, and commercial hunting and fishing. They are summarized in the table below.

Industries in Bass River Township

1. Recreation
   - a. camping
   - b. canoeing
   - c. hunting
   - d. trail hiking
   - e. horseback riding
   - f. sport fishing
   - g. ecological and natural history investigations

2. Agriculture
   - a. cranberry farming
   - b. blueberry farming

3. Commercial Fishing and Hunting
   - a. clams
   - b. trapping
   - c. oysters
   - d. other

4. Marina Operation
   - a. marina services
   - b. boat sales
   - c. boat construction

5. Service Industries
   - a. food service industries
   - b. automobile service industries
   - c. garden center

6. Crafts
   - a. craft manufacture
   - b. craft sales

Several of these classes of business and industry are closely dependent upon essential environmental qualities for their survival. Without these supporting qualities from the immediate environment, most of these industries would be eliminated. The table on the following page lists the environmental requirements for each of these industrial activities.

Environmental Requirements for Bass River Township's Industries

Industry or Activity	Environmental Requirements
Camping	Low population density Extensive open space much of it wooded Limitation of four campsites per acre Unpolluted air Unpolluted waters for recreational use Moderate highway access
Canoeing	Low population density Unpolluted surface waters Streams without blockades from dams or other engineered features
Horseback Riding	Low population density Accessible woodlands or other open spaces with unpaved roads or trails Unpolluted waters
Hunting	Open space in woodlands, fields, freshwater wetlands, tidal marsh lands Public lands containing one or more of the above
Trail Hiking	Woodlands and open fields Public lands containing one or more of the above
Sport Fishing	Fresh water streams or Brackish or salt water bodies Unpolluted waters in the above Extensive tidal marshes for fish food chain life support and breeding areas Availability of marina or docking and launching facilities
Ecological and Natural History Investigations	For ecological investigation and study of wild species a variety of supportive environments with low population density and relative freedom from pollution

Environmental Requirements (continued)

Industry or Activity	Environmental Requirements
Cranberry culture	Acid sandy loam soils Abundant rainfall Extensive open cleared land
Blueberry Culture	Acid, sandy loam soils High water table Hot days, cool nights Abundant rainfall Extensive open cleared land
Shellfishing	Unpolluted shallow waters and zones of salinity ranging from 1.005 - 1.030 specific gravity (5 - 30 parts/thousand) Tidal and coastal waters nourished by extensive tidal marshland areas Absence of soil erosion and deposition from improper development in areas draining to coastal waters Absence in fluctuations of salinity in bay waters resulting from too rapid storm drainage
Trapping	Unpolluted tidal marshes or fresh water streams and bays Low population density Availability of wetlands accessible for trappers
Marina Operation	Extensive open waters with characteristics needed for shellfishing or sport fishing Relative proximity to urban populations
Service Industries	Attractive highways and village scenery - the amenities of a picturesque highway for a low population density Vacation, recreation area Relative proximity to urban populations

The table demonstrates that the present industries which support Bass River Township residents depend completely upon several aspects of the Township's present environment. Without these environmental essentials, the industries would be eliminated with the exception, perhaps, of some of the service industries. The following report on

fishing in the Great Bay area is indicative of the kind of environment presently enjoyed by the residents of the Township. The residents earnestly desire that this kind of environment be maintained.

Water Related Activity in Bass River Township and Environs

Because of its physical location in the heart of the Wading River watersheds and its very proximity to the Mullica River - Great Bay Estuary, Bass River Township's economy includes the commercial shell fishing industry, the sports fishing industry and many forms of recreational fishing. Whether it be bank fishing, boat fishing, or ice fishing at Collin's Cove, all of these pursuits are part of Bass River Township's recreational picture.

Shell fishing accounts for a sizeable harvesting of oysters, clams, scallops or mussels. This local industry is completely dependent upon clean unpolluted waters if it is to survive. To preserve the quality of our waters must, therefore, be one of the goals of the projected master plan for Bass River Township.

Boat fishing, (fishing from a boat of any size or description) is a major activity in the area. Studies indicate that Great Bay is by far the most popular boat fishing area (easily reached from Bass River Marina on the Bass River) and downstream on the Wading and Mullica Rivers. Since it is known that a substantial proportion of the boaters are actually fishermen, a relationship between boat fishing areas and boating may be reasonably expected. Bank fishermen prefer Great Bay Boulevard by a substantial margin. The middle Mullica River is second in activity but a significant fact is that two -thirds of the activity entered in this category is ice fishing in January.

The estimated grand total of 105,366 man-days for all kinds of fishing activities is possibly a low statistic. A look at the table following should readily indicate the importance of fishing and boating to Bass River Township's economy.

Rank in Order of Frequency		Man-Days Per Year
1.	Boat Fishing	86,954
2.	Boating	26,500
3.	Bank fishing	10,891
4.	Shell fishing	7,521
5.	Ice Fishing	3,965
6.	Others	2,653
7.	Hunting (water fowl)	1,973
8.	Bathers	1,402
9.	Water skiers	777
	Grand Total	142,636

The detailed data from which the summary table above was developed is shown in the table following.

Estimated Totals of Man-Days for All Types of Activities by Month

Mullica-Great Bay Estuary

FISHING

	Bank	Boat	Boating	Shellfishing	Bathers	Water skiers	Hunters	Others	Total
January	3,965*	--	---	-----	---	----	----	----	3,993
February	33	40	158	134	---	---	---	40	405
March	1,134	1,744	451	92	---	---	---	96	3,517
April	2,863	12,092	1,656	721	---	---	---	172	17,504
May	1,656	11,486	2,233	1,275	---	---	---	167	16,817
June	853	16,210	4,955	1,171	396	137	---	478	24,200
July	1,025	17,344	4,812	1,669	421	108	---	423	25,802
August	1,491	17,075	6,803	1,379	502	387	---	856	28,493
September	911	8,085	2,973	271	83	145	173	153	12,794
October	371	2,165	1,549	388	---	----	463	154	5,090
November	533	552	567	279	---	---	660	70	2,661
December	21	161	343	114	---	---	677	44	1,360
Totals	10,891	86,954	26,500	7,521	1,402	777	1,973	2,653	142,636 - Grand Total

* Ice Fishing. The composite total for various kinds of fishing is 105,366.

Courtesy: Paul E. Hamer, Principal Fisheries Biologist, N.J. Bureau of Fisheries, Nacote Creek Experimental Station

Residents' Attitude Toward Development

The residents of Bass River Township are desirous of maintaining the quality of their present environment and all of the special natural amenities now to be found there. Although they expect growth and development to occur, the residents are strongly opposed to sudden major spurts of growth without effective regard for the environmental impact of such growth.

To recognize this desire, the residents elected a Board of Commissioners pledged to these objectives for the township. The Commissioners, in turn, have recruited an able group of citizens to serve on the Planning Board, the Board of Adjustment and the Environmental Commission. These municipal bodies have accepted the task of developing a Master Plan which will insure orderly growth while maintaining or improving environmental quality in the Township.

ERRATA

For:

Page 1, line 1 - read 79 square miles for 77 square miles.
Page 7, line 2 - read Florida for Flordia
Page 7, line 3 - read unconsolidated for unconcolidated
Page 7, line 33 - read orogeny for orogony
Page 9, line 4 - read named for hamed
Page 11, line 30 - read steel for stell
Page 14, line 4 - read sandy for sand
Page 14, line 22 - read 5 to 10 percent for 50 to 10 percent
Page 15 , line 3 - read because for becasue
Page 15, line 36 - read drained for rained
Page 26, line 10 - read Ballanger for Bellanger
Page 35, line 6 - read contamination for contaimination
Page 37, line 6 read - micaceous for micacious
Page 37, line 35 - read share for shore
Page 44, line 30 - delete incidence is
Page 44 , line 33 - add "berry" to the word "crow"
Page 45, line 15 read - specimens for speciments
Page 46, line 11 - read purple or purpole
Page 46, line 44 - read Oenothera for Cenothera
Page 48, line 3 - read Ludwigia for Lidwigia
Page 48, line 15 - read Asclepias for Ascelpias
Page 48, line 28 & 29 - Muhly one-flowered and Torrey's Muhly should be listed with grasses and shrubs
Page 48, line 45 - read Pinweed for Pineweed
Page 49, line 2 - read Oenothera for Centhera
Page 49, line 6 - read Eryngium for Ernygium
Page 49, line 7 - add sp?
Page 49, line 25 - read Cyparissias for Cuparissias
Page 49, line 35 - read Tanacetum vulgare for Tanacetums vlgare
Page 49, line 47 - read Xerophyllum for lerophyllum
Page 52, line 37 - read catbrier for cutbrier
Page 53, line 44 - read peregrina for perearina
Page 53, line 49 - read Ilex for Illex
Page 53, line 52 - read viburnum for Bivurnum
Page 53, line 53 - read Yucca for Ycca
Page 54, line 14 - read Mockernut for pale and tomentosa for pallida
Page 54, line 15 - read Ilex opaca for Ilex bpaca
Page 54, line 27 - add Willow Oak, Q. Phellos
Page 55, line 3 - read Thelypteris for Thalypteris
Page 60, line 7 - read Greater Yellowlegs for Giter Yellowlegs
Page 60 - line 40 - read Sharp Shinned for Sharp-Showned
Page 61, line 7, read Ruffed for ruffled
Page 61, line 34 - read Alder for Older
Page 62, lines 6 and 7 - insert marsh before wren
Page 63, line 3 - read water thrush for warbler

Errata (continued)

Page 65, line 15 - read Schmid for Schmidt
Page 65, line 19 - read beyond for byond
Page 66, line 24 - read ericoides L. for tomentosa Nutt.
Page 66, line 27 - read Gaultheria procumbens L. for Gaeltherea procumben L.
Page 67, line 29 - read ilicifolia for ilifolia
Page 67, line 37 - read ericoides L. for tomentosa Nutt.
Page 85, line 12 - delete 19 miles